Advanced Macroeconomics II
Monetary Policy

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Part of these slides are based on Jordi Galì slides for Macroeconomia Avanzada II.
The Basic New Keynesian Model

- NK Phillips Curve (NKPC)

\[ \pi_t = \beta E_t \{ \pi_{t+1} \} + \kappa \tilde{y}_t \]

with \( \tilde{y}_t \equiv y_t - y^*_t \) ("output gap").

- Dynamic IS Curve

\[ \tilde{y}_t = -\frac{1}{\sigma} (i_t - E_t \{ \pi_{t+1} \} - r^*_n) + E_t \{ \tilde{y}_{t+1} \} \]

- Interest rate rule

Example:

\[ i_t = \rho + \phi_\pi \pi_t + \phi_y \tilde{y}_t + \nu_t \]
Assume that: \( y_t = y_t^e \), or \( y_t - y_t^e = \text{const.} \).

\[
\begin{align*}
\tilde{y}_t &= E_t \tilde{y}_{t+1} - \sigma^{-1} (i_t - E_t \pi_{t+1} - r_t^e) \\
\pi_t &= \beta E_t \pi_{t+1} + \kappa \tilde{y}_t \\
\tilde{y}_t &= y_t - y_t^e \\
r_t^e &= \rho + \sigma E_t \Delta y_{t+1}^e
\end{align*}
\]

stabilizing inflation is equivalent of stabilizing the output gap, therefore there is no trade-off between inflation and output/unemployment. In fact, solving forward the Phillips curve:

\[
\pi_t = \kappa \sum_{i=0}^{\infty} \beta^i E_t \tilde{y}_{t+i}
\]

set \( \tilde{y}_t = 0 \) then \( \pi_t = 0 \) \( \implies \) STRICT INFLATION TARGETING IS THE OPTIMAL POLICY! The so called "divine coincidence" holds (Blanchard Galì (2006 JMCB)).
IMPLEMENTABILITY of the OPTIMAL RULE in the absence of a trade-off

- Notice $\pi_t = 0$ implies $\tilde{y}_t = 0$ and therefore from the IS curve the optimal interest rate is:

$$i_t = r^n_t$$

(1)

- Is the optimal rule implementable? NO: Multiple Equilibria

- Alternative rule: A simple Taylor Rule

$$i_t = \rho + \phi_\pi \pi_t$$

with $\phi_\pi > 1$ the simple rule implies a unique equilibrium, $\implies$ implementable!
Welfare based Loss-Function (second order approximation of Households Utility)

\[ \mathcal{L} = \frac{\epsilon}{\lambda} \left[ \frac{\kappa}{\epsilon} \text{var}(\tilde{y}_t) + \text{var}(\pi_t) \right] \]

Example:

\[ i_t = \rho + \phi_\pi \pi_t + \phi_y \tilde{y}_t \]
### Evaluation of the Simple Taylor Rule

<table>
<thead>
<tr>
<th>Parameter</th>
<th>( \phi_\pi )</th>
<th>( \phi_y )</th>
<th>( \sigma(\tilde{y}) )</th>
<th>( \sigma(\pi) )</th>
<th>Welfare Loss</th>
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</thead>
<tbody>
<tr>
<td>( \phi_\pi )</td>
<td>1.5</td>
<td>1.5</td>
<td>5</td>
<td>1.5</td>
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<tr>
<td>( \phi_y )</td>
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<td>1</td>
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<tr>
<td>( \sigma(\tilde{y}) )</td>
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<td>0.28</td>
<td>0.04</td>
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<td>( \sigma(\pi) )</td>
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<td>1.33</td>
<td>0.21</td>
<td>6.55</td>
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<tr>
<td>Welfare Loss</td>
<td>0.30</td>
<td>0.08</td>
<td>0.002</td>
<td>1.92</td>
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MONETARY POLICY TRADE-OFFs

- In the model analyzed so far the Central Bank does not face any trade-off between stabilizing output and inflation and therefore **strict inflation targeting is the optimal policy**!

- The analysis is not realistic! Central Banks face significant trade-offs at least in the short run
Clarida, Galì, Gertler (1999 JEL) - **Result 1:** To the extent cost-push inflation is present, there exists a short run trade-off between inflation and output variability.

The presence of short run trade-offs have led inflation targeting central banks to pursue a policy that allows for a partial accommodation of inflationary pressures in the short run, in order to avoid too large instability of output and employment, while remaining committed to a medium term inflation target. A policy of that kind is often referred to in the literature as "flexible inflation targeting".
EXOGENOUS TRADE-OFF

\[ x_t = E_t x_t - \sigma^{-1} (\hat{\pi}_t - E_t \pi_{t+1} - r_t^e) \]
\[ \pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t \]

where

- \( u_t \) is an AR (1) cost-push shock (supply shock) attached to the NKPC:
  \[ u_t = \rho_u u_{t-1} + \varepsilon_{u,t} \]

- \( r_t^e \) is the efficient interest rate:
  \[ r_t^e = \rho + \sigma E_t \Delta y_{t+1}^e \]

- **Notice:** \( x_t = y_t - y_t^e \) is the welfare relevant output-gap.
**Endogenous output/inflation trade-off**

Assume that

\[ y_t^e - y_t^n \neq \text{const} \]

then \( x_t = y_t - y_t^e \) is the welfare relevant output gap, and given that

\[
\begin{align*}
y_t - y_t^n &= y_t - y_t^e + y_t^e - y_t^n \\
&= x_t + y_t^e - y_t^n
\end{align*}
\]

then the dynamic system becomes

\[
\begin{align*}
x_t &= E_t x_t - \sigma^{-1} (\hat{i}_t - E_t \pi_{t+1}) \\
\pi_t &= E_t \pi_{t+1} - \kappa x_t - \kappa (y_t^e - y_t^n)
\end{align*}
\]

\( \kappa (y_t^e - y_t^f) \) is a function of the shocks and of the structural parameters (microfounded). Stabilizing inflation is not sufficient for stabilizing the output gap, an **endogenous trade-off** emerges! **STRICT INFLATION TARGETING IS NOT OPTIMAL!**
Optimal Monetary Policy (II): Efficient Natural Equilibrium

- As Before assume that: \( y_t^n - y_t^e \) is not constant but varies over time
- The welfare relevant output gap is
  \[
  x_t \equiv y_t - y_t^e
  \]

- NKPC
  \[
  \pi_t = \beta E_t \{ \pi_{t+1} \} + \kappa x_t + u_t
  \]
  with \( u_t \equiv \kappa (y_t^e - y_t^n) \)
  \[\mapsto\] Endogenous Trade-off!

- Dynamic IS
  \[
  x_t = -\frac{1}{\sigma} (i_t - E_t \{ \pi_{t+1} \} - r_t^e) + E_t \{ x_{t+1} \}
  \]
  with \( r_t^e \equiv \rho + \sigma E_t \{ \Delta y_{t+1}^e \} \)
- **Simple Rule**
  \[ i_t = \rho + \phi_\pi \pi_t \]

- **Equilibrium**
  Assume: (i) \( \{\Delta a_t\} \sim i.i.d. \rightarrow r_t^e = \rho \), (ii) \( \{u_t\} \sim i.i.d. \)
  \[ \pi_t = \frac{\sigma}{\sigma + \kappa \phi_\pi} u_t \]
  \[ x_t = -\frac{\phi_\pi}{\sigma + \kappa \phi_\pi} u_t \]

- **Loss Function**
  \[ \alpha \text{var}(x_t) + \text{var}(\pi_t) \]

- **Optimal Rule:**
  \[ \phi^*_\pi = \frac{\sigma \kappa}{\alpha} \]

- **Welfare loss:** \( \alpha \equiv \frac{\kappa}{\varepsilon} \quad \Rightarrow \quad \phi^*_\pi = \sigma \varepsilon \)
The Taylor Rule (Taylor 1993)

\[ i_t = 4 + 1.5(\pi_t - 2) + 0.5y_t \]

Source: Taylor 1999
Clarida, Galì, Gertler (2000 QJE)

\[ i_t = \rho i_{t-1} + (1 - \rho) \left[ r + \pi^* + \beta E_t \{ \pi_{t+1} - \pi^* \} + \gamma \beta E_t \{ x_{t+1} \} \right] \]

<table>
<thead>
<tr>
<th>Baseline Estimates</th>
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<tbody>
<tr>
<td>( \pi^* )</td>
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<tr>
<td>Pre-Volcker</td>
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<td>Volcker-Greenspan</td>
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Standard errors are reported in parentheses. The set of instruments includes four lags of inflation: output gap, the federal funds rate, the short-long spread, and commodity price inflation.