PUBLISHING THE CENTRAL BANK’S INTEREST RATE PROJECTIONS AND LEARNING

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Possible strategy: communicate *short term interest rate path*.
Pros

- it helps to enforce the optimal policy under commitment (Woodford, 2005; Svensson, 2004);
- it increases the predictability of policy decisions;
- it allows the market to price more efficiently financial assets (Kahn, 2007).

Cons

- useless if the central bank is already very transparent in many other dimensions (Khan, 2007);
- harmful if the public does not understand its conditional nature (Woodford, 2005; Mishkin, 2004).
Theoretical Literature

- Apparently, if CB has an information advantage, the benefits of the publication of the interest rate path overcome the costs, but it is not always the case.

Eusepi and Preston (2007)

Hypothesis: Private agents are uncertain about the statistical properties of aggregate variables and must learn using historical data.

Main result: communicating the entire policy decision process (i.e. the relevant conditioning variables and policy coefficients) anchors expectations and promote macroeconomic stability.

Rudebusch and Williams (2006)

Hypothesis: everything is known by the public but the parameters of the policy rule or the inflation target.

Main result: in general, the publication of interest rate projections reduces macroeconomic fluctuations. Opposite result if private agents do not know the accuracy of central bank signals.
The unresolved debate about the value of the direct signaling of policy intentions provides the key motivation.

We study the effects of publishing the central bank's interest rate projection when

1) private agents form forecasts by learning from past data.
2) central bank sets the interest rate as a reaction function to output and inflation.
3) the policy path published by the central bank is the conditional interest rate under rational expectations.
CBs use general equilibrium models where interest rates are endogenously determined and the expectations are assumed to be perfectly rational.

The Swedish Risksbank

uses a macroeconomic general equilibrium model that “can be formulated mathematically as a system of non-linear differential equations with rational expectations”.

The Norges Bank

produces the forecasts using a core macroeconomic DSGE model with “rational agents reacting to exogenous disturbances”.

Motivations & Main Assumptions (2)
The Central Bank of Island

uses a model called QMM where expectations “are assumed to be rational, i.e. consistent with the QMM model structure”.

The Reserve Bank of New Zealand

uses a general equilibrium macro model, where expectations are modeled “as some weighted combination of the model-consistent forecast and some other function of the recent data”.

Motivations & Main Assumptions (3)
Objectives & Main Results

- Effects of the publication of the interest rate path:
  - on the set of policies under which agents learn the REE;
  - on the speed of learning;

- Effects of announcing the path of inflation and output gap.

- Publishing the interest rate projections makes conditions for learnability more stringent and the learning process slower.

- Publishing output gap and inflation projections has opposite implications.
The Baseline Model – No announcement

Standard New Keynesian structure where CB has RE and private agents know the states of the economy, but do not know how these determine the actual value of the main macroeconomic variables.

- **IS curve:** \( x_t = E^*_t x_{t+1} - \phi(i_t - E^*_t \pi_{t+1}) + g_t \)

- **AS curve:** \( \pi_t = \alpha x_t + \beta E^*_t \pi_{t+1} + u_t \)

- **Taylor type rule:** \( i_t = \gamma + \gamma_\pi \pi_t + \gamma_x x_t \)

The economy evolves according to:

\[
\begin{align*}
y_t &= \begin{bmatrix} \pi_t \\ x_t \end{bmatrix} \\
w_t &= \begin{bmatrix} u_t \\ g_t \end{bmatrix}
\end{align*}
\]

\[
y_t = Q + F\hat{E}_t y_{t+1} + Sw_t
\]

\[
w_t = \Psi w_{t-1} + \Omega \varepsilon_t
\]
**REE vs Learning – No announcement**

\[
y_t = Q + F E_t^* y_{t+1} + S w_t
\]
\[
w_t = \Psi w_{t-1} + \Omega \varepsilon_t
\]

- **MSV solution under Rational Expectations:** \( E_t y_{t+1} = A + B \Omega w_t \)

- **Least Squares Learning:** \( E_t^* y_{t+1} = A_t + B_t \Omega w_t \)

\[
\beta_t = \beta_{t-1} + t^{-1} R_t^{-1} z_{t-1} \left( y_{t-1}' - z_{t-1}' \beta_{t-1} \right)
\]
\[
R_t = R_{t-1} + t^{-1} \left( z_{t-1} z_{t-1}' - R_{t-1} \right)
\]
\[
z_t' = (1, u_t, g_t)
\]
E-Stability – No announcement

\[
y_t = Q + FE_t^* y_{t+1} + Sw_t
\]
\[
w_t = \Psi w_{t-1} + \Omega \varepsilon_t
\]

E-Stability: all the eigenvalues of \( F \) have real part smaller than one

As shown in Bullard and Mitra (2002) necessary and sufficient condition for the MSV solution to be E-stable:

\[
\gamma_\pi > 1 - \frac{1 - \beta}{\alpha} \gamma_x
\]
Forward-Looking Representation

Write the Phillips curve and the IS curve in terms of the expected short-term real interest rate, inflation and output gap $T$ periods in the future:

$$x_t = E^*_t x_{t+T} - E^*_t \sum_{j=0}^{T-1} (\varphi_i t+j - \varphi \pi t+j+1 - g t+j)$$

$$\pi_t = \beta^T E^*_t \pi_{t+T} + E^*_t \sum_{j=0}^{T-1} \beta^j (\alpha x_{t+j} + u_{t+j})$$

Relevant not only the actual real interest rate, but also the expected future short term real interest rates in determining today output and inflation.
Let's consider for simplicity the case with $T = 2$.

$$\pi_t = \beta^2 E_t^* \pi_{t+2} + \alpha x_t + u_t + \beta \alpha E_t^* x_{t+1} + \beta E_t^* u_{t+1}$$

$$x_t = E_t^* x_{t+2} - \varphi (i_t - E_t^* \pi_{t+1} + E_t^* i_{t+1} - E_t^* \pi_{t+2}) + g_t + E_t^* g_{t+1}$$

- Ferrero and Secchi (2009) study the case of the Reserve Bank of New Zealand and show that market expectations on short term interest rates respond in a significant and consistent way to the unexpected component of the published path, but adjustment is not complete.
Private agents expectations depend on both central bank’s announcement and their own expectation. 

\[ 0 \leq (1 - \lambda_1) \leq 1 \]

weight that agents give to the central bank’s announcement

\[ E_t^P i_{t+1} = (1 - \lambda_1) E_t^{CB} i_{t+1} + \lambda_1 E_t^* i_{t+1} \]

where CB expectation is obtained from the MSV solution

\[ E_t^{CB} i_{t+1} = a_i + \rho_u b_{u,i} u_t + \rho_g b_{g,i} g_t \]

under learning, the economy evolves according to

\[ y_t = \bar{Q} + \bar{F} \times E_t^* Y_{t+1} + \bar{V} \times E_t^* Y_{t+2} + \bar{S} w_r \]
In an economy where (i) at time $t$ the central bank publishes the time $t+1$ interest rate projection consistent with the REE and (ii) private agents give weight $0 \leq (1-\lambda_t) \leq 1$ to this projection,

- revealing the interest rate path makes conditions for **E-stability** more stringent than under no announcement.
- In particular, the necessary and sufficient condition for **E-stability** of the REE is

$$\gamma'_{\pi} > \frac{2}{(1 + \lambda_t)} - \frac{1 - \beta}{\alpha} \gamma'_x.$$ 

Under no communication we have seen that the necessary and sufficient condition was:

$$\gamma'_{\pi} > \frac{(1 - \beta)}{\alpha} \gamma'_x.$$
A well known result:
- When the interest rate is set as a response only to exogenous shocks ("fundamental" reaction function), small deviations from the equilibrium cannot be offset.

By publishing the interest rate projection consistent with the REE, the central bank
- is announcing a policy rate that behaves like a "fundamental" reaction function
- therefore, it is unable (or less able) to offset initial deviations from the equilibrium
- to offset this effect, the response of the policy to inflation has to be larger than in the case of no announcement
E-stability (3)

Figure 1 - E-stability and policy path announcement

Publishing the central bank’s interest rate projections and Learning – G. Ferrero, A. Secchi
We use the concept of speed of convergence to refine further the set of "good" policies.

\[
y_t = \tilde{Q} + \tilde{F} \times E_t^* Y_{t+1} + \tilde{V} \times E_t^* Y_{t+2} + \tilde{S} w_t
\]

\[
w_t = \Psi w_{t-1} + \Omega \varepsilon_t
\]

If all eigenvalues of \((\tilde{F} + \tilde{V})\) have real part smaller than 1/2

\[
\sqrt{t}(\beta_t - \bar{\beta}) \xrightarrow{D} N(0, \Omega_\beta)
\]

The bigger the real part of the biggest eigenvalue, the larger \(\Omega_\beta\)
Proposition 2

In an economy where (i) at time \( t \) the central bank publishes the time \( t+1 \) interest rate projection consistent with the REE and (ii) private agents give weight \( 0 \leq (1-\lambda_i) \leq 1 \) to this projection

- the smaller the weight to the announcement, the smaller the set of policies under which private agents learn at root-\( t \) speed
Figure 2 – E-stability and root-T convergence
for \((\lambda_1 = 1)\) and \((\lambda_1 = 0)\)
If all eigenvalues of \( (\tilde{F} + \tilde{V}) \) have real part smaller than 1, but bigger than 1/2, through simulations we can compute

\[
t^\delta (\beta_t - \overline{\beta}) \xrightarrow{D} F
\]

### Speed of Convergence (1)

<table>
<thead>
<tr>
<th>( \gamma_x )</th>
<th>( \gamma_\pi = 1.5 )</th>
<th>( \gamma_\pi = 2.5 )</th>
<th>( \gamma_\pi = 3.5 )</th>
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<tr>
<td></td>
<td>( \lambda = 1 )</td>
<td>( \lambda = 0 )</td>
<td>( \lambda = 1 )</td>
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<tr>
<td>( \gamma_x = 0.25 )</td>
<td>( k )</td>
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<td>&gt;1</td>
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<td>( \gamma_x = 0.5 )</td>
<td>( k )</td>
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<td>( T_{1/2} )</td>
<td>&gt;400</td>
<td>N.A.</td>
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<td></td>
<td>( T_{1/3} )</td>
<td>&gt;400</td>
<td>N.A.</td>
</tr>
</tbody>
</table>
Proposition 3

In an economy where (i) at time $t$ the central bank publishes the time $t+1$ interest rate projection consistent with the REE and (ii) private agents give weight $0 \leq (1-\lambda_1) \leq 1$ to this projection,

- the smaller $(1-\lambda_1)$, the smaller has to be $\gamma_\pi$ in order to reach the same speed of convergence, or
- for a given combination of $\gamma_x, \gamma_\pi$, the smaller $(1-\lambda_1)$, the smaller is $k$ and the faster the learning process.
Figure 3 – Speed of Convergence Isoquants

Publishing the central bank’s interest rate projections and Learning – G. Ferrero, A. Secchi
Private agents expectations about inflation and output gap depend on both CB’s announcement and their own expectation

\[ 0 \leq (1 - \lambda_2) \leq 1 \]

weight that agents give to the central bank's announcement

\[ E_t^P y_{t+1} = (1 - \lambda_2) E_t^{CB} y_{t+1} + \lambda_2 E_t^* y_{t+1} \]

where CB expectation is obtained from the RE MSV solution

\[ E_t^{CB} y_{t+1} = A + B \Psi w_t \]

and, under learning, the economy evolves according to

\[ Y_t = \tilde{Q} + \tilde{F} \times E_t^* Y_{t+1} + \tilde{V} \times E_t^* Y_{t+2} + \tilde{S} w_t \]
Proposition 4

In an economy where (i) the central bank publishes only the inflation and output gap projections (consistent with the REE) and (ii) private agents give weight $0 \leq (1-\lambda_2) \leq 1$ to those projections, revealing the inflation and output gap paths makes

- conditions for E-stability less stringent than under no announcement
- and the speed of convergence higher
Figure 4 – E-stability and root-T convergence

\[(1 - \lambda_2) = 0.25\]
The main difference between the announcement of the policy path and the inflation and output gap paths:

- while the information about the interest rate (the instrument variable of the model) is \textit{implicitly used by private agents in order predict} future inflation and output (the control variables of the model),
- information about output gap and inflation is \textit{used directly to predict} those variables.
Proposition 5

In an economy where (i) at time $t$ the central bank publishes the time $t+1$ interest rate, inflation and output gap projections consistent with the REE and (ii) private agents give weights $0 \leq (1-\lambda_1) \leq 1$ to the former and $0 \leq (1-\lambda_2) \leq 1$ to the latter, iff

\[
0 \leq \lambda_1 < 2 - \frac{(1 - \lambda_2) (1 - \beta^2 \lambda_2)}{\lambda_2 \alpha \varphi (1 + \beta \lambda_2)} - \frac{1}{\lambda_2}
\]

conditions for E-stability under no announcement are less stringent than under announcement
Figure 5 – Weights under which the announcement of the paths reduces the region of E-stability
Conclusions

- In a world where (i) private agents are learning from past data, (ii) the central bank publishes the interest rate projection consistent with the REE and (iii) it is not taking into account the fact that agents are learning,
  - the CB is acting as if the expected interest rates are determined by a "fundamental" policy rule and, therefore,
  - it makes conditions for E-stability more stringent and
  - the learning process slower than under no announcement.
  - To offset this effect, the response of the policy to inflation has to be larger than in the case of no announcement.

- Announcement of expected inflation and output gap has an opposite effects.
The End