PRICE STABILITY AND OUTPUT GAP STABILIZATION

Vitor Gaspar
Frank Smets
David Vestin

European Central Bank

“The man of system (…) is often so enamoured with the supposed beauty of his own ideal plan of government, that he cannot suffer the smallest deviation from any part of it. He goes on to establish it completely in all its parts without any regard either to the great interests, or to the strong prejudices which may oppose it. He seems to imagine that he can arrange the different members of a great society with as much ease as the hand arranges the different pieces upon a chess-board. He does not consider that the pieces upon the chess-board have no other principle of motion besides which the hand impresses upon them; but that, in the great chess-board of human society, every single piece has a motion principle of its own, altogether different from what the legislature might chuse to impress upon it. If those two principles coincide and act in the same direction, the game of human society will go on easily and harmoniously, and is very likely to be happy and successful. If they are opposite or different, the game will go on miserably, and the society must be at all times in the highest degree of disorder.”

Adam Smith, *The Theory of Moral Sentiments*, Liberty Fund, 1984, pp. 233-34.

Starting Point:

Complementarity between price stability and overall macroeconomic stability (i.e. stability of the output gap)

Blinder (1998)
Clarida, Gali and Gertler (1999)
Goodfriend and King (1997, 2001)
Woodford (2002)
• • •

Policy should offset demand shocks and accommodate supply shocks.

- Time inconsistency and Rogoff's conservative central banker

- Potential output uncertainty and robust monetary policy

- Private sector learning and the focus on price stability

The simplest Model

(1) $$\pi_t = \beta E_t \pi_{t+1} + \kappa(y_t - \bar{y}_t) + u_t = \beta E_t \pi_{t+1} + \kappa z_t + u_t$$

(for simplicity β = 1)

(2) $$u_t = \rho u_{t-1} + v_t$$

(3) $$- W = E_t \sum_{i=0}^{\infty} \beta^i ((\pi_{t+i} - \bar{\pi})^2 + \lambda (z_{t+i})^2)$$

2. COST PUSH SHOCKS MEET CONSERVATIVE CENTRAL BANKER

- If target output coincides with flexible prices output there is complementarity between inflation and output gap stability.

- Optimal time consistent policy is given by:

$$z_t = -\frac{\kappa}{\lambda}(\pi_t - \bar{\pi}) = -\alpha(\pi_t - \bar{\pi})$$

- Creates a trade-off between output gap and inflation stabilisation with cost-push shocks

$$(7) \qquad z_t = -\frac{\kappa}{\kappa^2 + \lambda(1-\rho)} u_t$$

$$(8) \qquad \pi_t = \bar{\pi} + \frac{\lambda}{\kappa^2 + \lambda(1-\rho)} u_t$$

- The optimal degree of conservativeness

$$(9) \qquad \alpha^* = \frac{\alpha}{1-\rho} \qquad \qquad \alpha = \frac{\kappa}{\lambda}$$

3. POTENTIAL OUTPUT UNCERTAINTY AND OUTPUT GAP STABILISATION

The CB observes shocks to aggregate supply but does not have information on the nature of the shock:

- supply (productivity) shocks;
- cost - push shocks.

Losses under alternative assumptions

	Shock is a supply shock	Shock is a cost-push shock
CB assumes a supply shock	$L_{SS} = 0 + 0$	$L_{CS} = \frac{1}{1-\beta\rho^2}\left[0 + \lambda \frac{1}{\kappa^2}\right]$
CB assumes a cost-push shock	$L_{SC} = \frac{1}{1-\beta\rho^2}\left[\frac{\lambda^2}{q^2} + \lambda\left(\frac{q-\kappa^2}{\kappa q}\right)^2\right]$	$L_{CC} = \frac{1}{1-\beta\rho^2}\left[\frac{\lambda^2}{q^2} + \lambda \frac{\kappa^2}{q^2}\right]$
Maximum loss (compared to the optimal)	$L_{SC} - L_{SS} = \frac{1}{1-\beta\rho^2}\frac{\lambda^2\left[\kappa^2 + \lambda(1-\beta\rho)^2\right]}{\kappa^2 q^2}$	$L_{CS} - L_{CC} = \frac{1}{1-\beta\rho^2}\left[\frac{\lambda^2\left[\kappa^2 + \lambda(1-\beta\rho)^2\right]}{\kappa^2 q^2} - \frac{2\lambda^2\beta\rho}{\left[\kappa^2 + \lambda(1-\beta\rho)\right]^2}\right]$

The difference between the two maximum losses is given by: $(L_{CS} - L_{CC}) - (L_{SC} - L_{SS}) = -\frac{2\lambda^2\beta\rho}{(1-\beta\rho^2)\left[\kappa^2 + \lambda(1-\beta\rho)\right]^2}$

4. LEARNING AND STABILISATION

Departure from RE. Private sector has to learn about inflation dynamics.

Under RE:

(19) $$\pi_t^{RE} = (1-\rho)\bar{\pi} + \rho\pi_{t-1}^{RE} + \frac{\gamma}{1-\gamma\rho}v_t$$

Following Orphanides and Williams (2002) we assume that private agents estimate:

(20) $$\pi_t = c_{0,t} + c_{1,t}\pi_{t-1} + \omega_t$$

using constant-gain learning à la Evans and Honkapohja (2001).

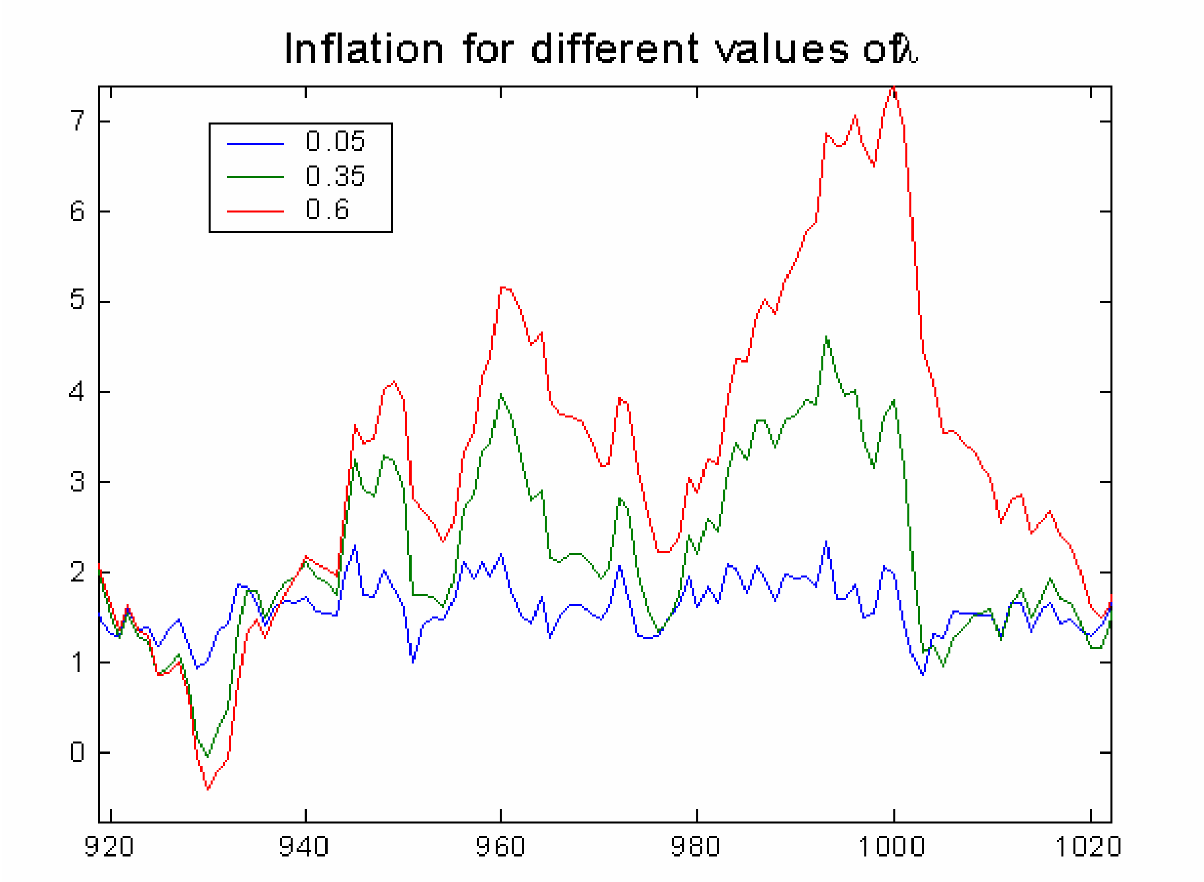
Assumptions:

slope of Philipps curve:	$\kappa = 0{,}2$
persistence of shocks:	$\rho = 0{,}4$
variance of ν :	$\sigma^2_\nu = 0{,}2$
constant gain parameter:	$\phi = 0{,}025$ (equivalent window 80 periods)

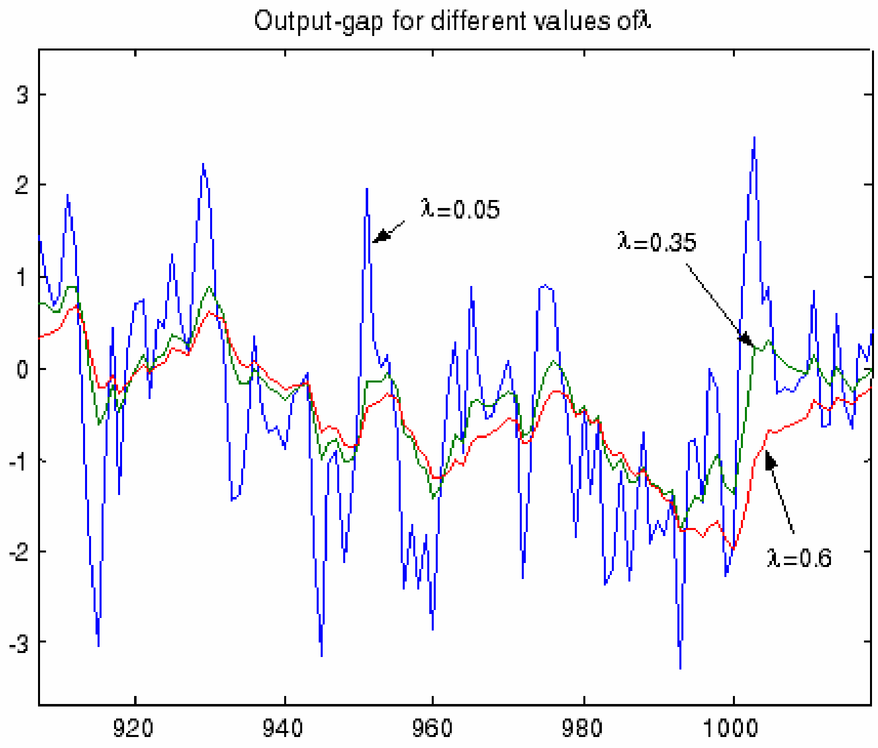
Experiences: $\lambda = 0{,}05$; $0{,}35$; $0{,}60$

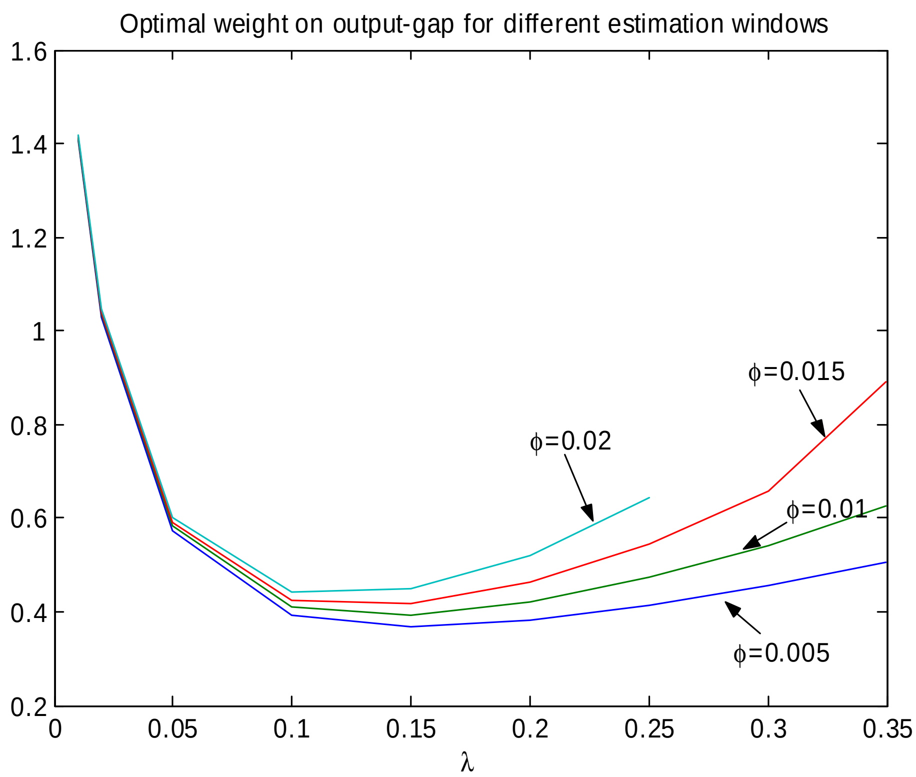
Graph 1
- 1a) Inflation
- 1b) Output gap
- 1c) Estimated ρ

Graph 2 Optimal weight for different constant gain parameters

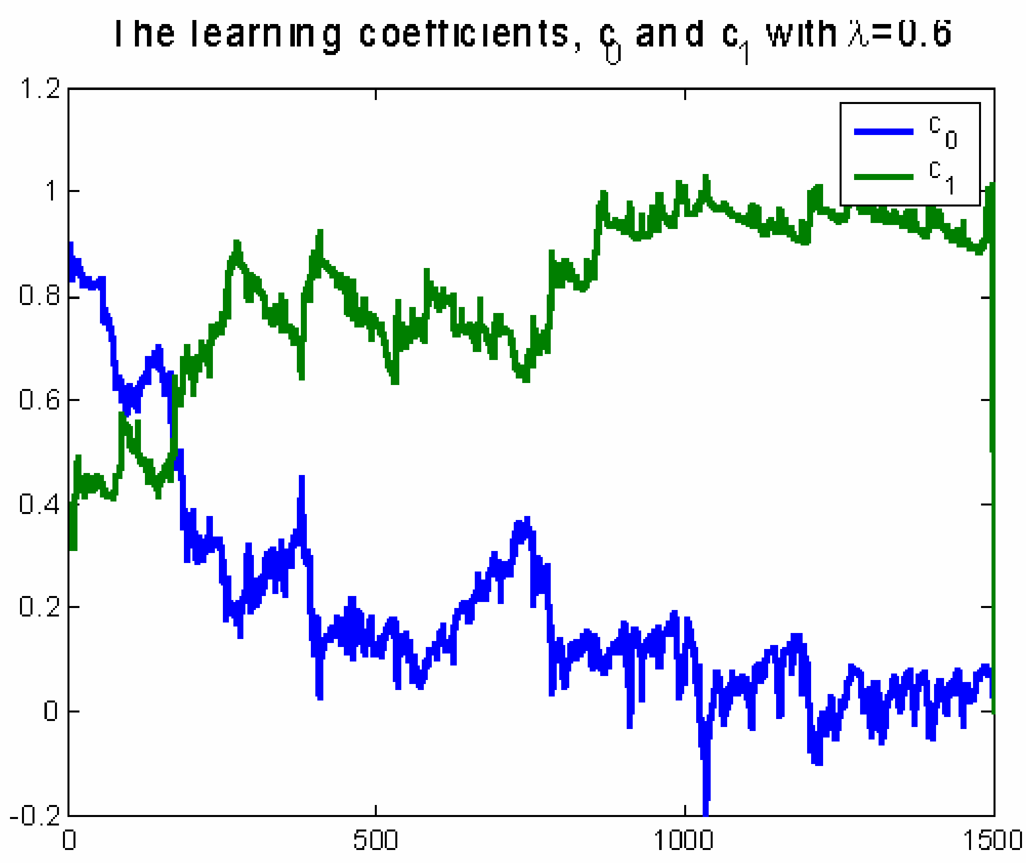


Inflation for different values of λ
0.05
0.35
0.6
7
6
5
4
3
2
1
0
920
940
960
980
1000
1020


Output-gap for different values of λ
λ=0.05
λ=0.35
λ=0.6
3
2
1
0
-1
-2
-3
920
940
960
980
1000



True weight is assumed to be 0.35 in this figure


The learning coefficients, c0 and c1 with λ=0.6
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
500
1000
1500
c0
c1

5. ESCAPE INTUITION

- What drives an escape is the persistence of inflation expectations
- The source of this persistence is the estimated c_1 in $\pi_t = c_0 + c_1 \pi_{t-1}$
- The aggressiveness of policy affects the scope for build-ups in c_1
- One way to characterise an escape is by looking at the minimum value of the shock needed to sustain the escape.
- Illustrate how policy affects this value in the Lucas model (intuition carries over!)

Lucas model

- $\pi_t = E_{t-1}\pi_t + \kappa x_t + u_t$
- The updating equations for the parameters are

$$c_t = c_{t-1} + \phi R_t^{-1} x_t (y_t - x_t' c_{t-1})$$
$$R_t = R_{t-1} + \phi (x_t x_t' - R_{t-1})$$

- In the Lucas case, $$c_{1t} = c_{1t-1} + \frac{\phi}{|D|}(-a + \pi_{t-1})(\pi_t - E_{t-1}\pi_t)$$
- where a is a weighted sum of past inflation rates, $$a = \phi \sum_{i=0}^{\infty} (1-\phi)^i \pi_{t-1-i}$$
- During an inflationary escape, $a < \pi_{t-1}$ -> $c_{1t} > c_{1t-1}$ iff $\pi_t > E_{t-1}\pi_t$
- $$foc: \pi_t = -\frac{\lambda}{\kappa} x_t$$
- $$\pi_t = \gamma (E_{t-1}\pi_t + u_t)$$

$$u_t > (1-\gamma) E_{t-1}\pi_t$$

$$\gamma = \frac{\lambda}{\lambda + \kappa^2}$$

λ up -> u down
and thus an escape more likely

6. A SIMPLE EXTENSION: A ROLE FOR OUTPUTGAP EXPECTATIONS

- The results are robust to the simplest extension of the model. I.e. the consideration of a simple forward-looking IS curve
- $z_t = E_t z_{t+1} - \sigma(i_t - E_t \pi_{t+1}) + \nu_t$
- which embodies a very simple version of the transmission mechanism.
- the argument is analogous to the one used to show that demand shocks do not create a trade-off. The central bank will undo whatever effect such a sock may have through an appropriate adjustment of the interest rate.
- Assuming the same learning algorithm for inflation as before the mechanism used to form expectations about the output gap does not matter.

7. CONCLUSIONS

- Even considering a trade-off induced by cost-push shocks, focusing on price stability is still a good idea given endogenous expectations.

- The dynamics of learning about future inflation provides a new rationale for a conservative central banker