

# Materials 1

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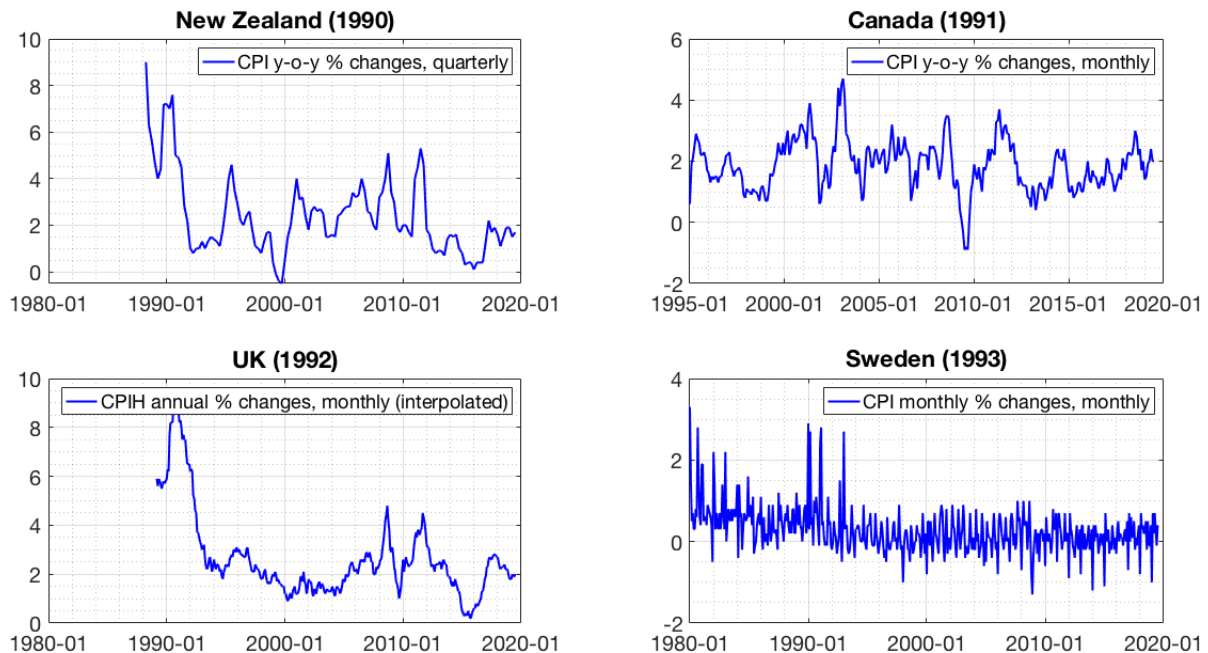
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## 1 Some inflation targeting countries

Figure 1: 4 inflation targeting countries (switch to IT year in brackets)



## 2 Cost-push shock in NK model w/o and w/ learning - Intuition

Same clarification (based on Justiniano & Primiceri's Bank of Belgium presentation 2010):

- efficient output: output under flexible prices and no distortions
- potential output: output under flexible prices but imperfect competition, yet constant markups
- natural output: output under flexible prices but imperfect competition AND nominal frictions (time-varying markups)

→ Eric Sims: “2 distortions in the NK model: LR distortion (imperfect competition) and SR distortion (price rigidity).” I think:

1. In st.st, potential output = natural output.
2. In an NK model, mon. policy stabilizes actual output to potential output (= st.st. natural output). In other words, mon. pol can't undo a LR distortion because money is neutral in the LR.

A cost-push shock:

- is a shock to the steady-state markup  $\mu$ :  $\mu = \frac{\theta}{\theta-1}$ , where  $\theta$  = el. of substitution between varieties  
→ it's a shock to the level of LR distortions (to the distance to perfect competition).
- Note that a cost-push shock isn't the only thing that can move markups in the NK model: out of st.st., marginal costs are an increasing function of demand (and thus of output gaps), and so demand shocks increase marginal costs, decreasing markups.
- I think it is for this reason that Clarida, Gali & Gertler (1999) call cost-push shocks “all shocks that are not demand that move markups.”

Why think about cost-push shocks? → because they are the only shock that introduces an inflation-output gap tradeoff for the mon. authority. Key point: I think that this tradeoff is amplified if expectations are allowed to move around. That is, I think one can make a case for anchoring expectations here. I'm going to lay out the argument in three steps:

- Clarida, Gali & Gertler (1999)'s Result 1: for mon. policy w/o commitment, cost-push shocks introduce an inflation-output gap tradeoff in a NK model. If expectations are allowed to adjust, the tradeoff is amplified.

- Let's see the same intuition on the plain-vanilla 3-equation NK model w/ commitment (a Taylor rule). If expectations are allowed to adjust, the tradeoff is amplified.
- Let's look at the CEMP economy: we can see the same intuition at work as in the 3-equation NK model.

## 2.1 Clarida, Gali & Gertler (1999)'s Result 1

The CB's problem is the standard mon. policy problem under discretion:

$$\max -\frac{1}{2}(\alpha x_t^2 + \pi_t^2) + F_t \quad \text{s.t.} \quad \pi_t = \lambda x_t + f_t \quad (1)$$

where expectations  $F_t$  and  $f_t = \beta \mathbb{E} \pi_{t+1} + u_t$  are taken as given by the CB, and  $u_t$  is a cost-push shock (appended to the NKPC). Optimality conditions to this problem, subbing  $f_t$  in, are:

$$x_t = -\frac{\lambda}{\alpha + \lambda^2}(\beta \mathbb{E} \pi_{t+1} + u_t) \quad (2)$$

$$\pi_t = \frac{\alpha}{\alpha + \lambda^2}(\beta \mathbb{E} \pi_{t+1} + u_t) \quad (3)$$

- A favorable cost-push shock ( $\theta \uparrow, u_t \downarrow$ , that is we move towards perfect competition)  $\rightarrow x_t \uparrow, \pi_t \downarrow$ .
- If  $\mathbb{E} \pi_{t+1}$  is allowed to move (unanchored), it will decrease over time, amplifying the shock. (I'm implicitly assuming RLS learning for the expectation formation.)

## 2.2 The 3-equation NK model

$$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + \kappa x_t + u_t \quad (4)$$

$$x_t = \mathbb{E}_t x_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t \pi_{t+1}) + \frac{1}{\sigma} r_t^n \quad (5)$$

$$i_t = \delta_\pi \pi_t + \delta_x x_t \quad (6)$$

- $u_t \downarrow \rightarrow \pi_t \downarrow$  (my intuition tells me that  $x_t$  should go up because less market power means higher quantities, lower prices, but I fail to see it here).
- If mon policy reacts, as the TR tells it to, it lowers interest rates, leading to a rise in output gaps. Voila.
- Again, if expectations are allowed to move, assuming RLS learning,  $\mathbb{E} \pi_{t+1} \downarrow$ , pushing inflation down further, amplifying the shock.

- Although expectations moving also helps you a bit, because it balances some of the increase in  $x_t$ . (?)

### 2.3 CEMP (w/o specified mon. policy)

$$k_t = \mathbf{f}_k \tag{7}$$

$$\bar{\pi}_t = \mathbf{f}_\pi + \mathbf{f}_k^{-1} \eta_{t-1} \tag{8}$$

$$\xi_t = \mathbf{f}_\xi + \mathbf{A}_\xi \xi_{t-1} + S_\xi \begin{pmatrix} \epsilon_t \\ \mu_t \end{pmatrix} \tag{9}$$

where  $\xi = (\eta, \varphi, \pi)'$ , and  $\pi$  is described by a hybrid Phillips-curve with marginal cost shocks (shock  $\epsilon$  on  $\varphi$ ) and markup shocks  $\mu_t$ , and  $\eta_t = \mu_t + \epsilon_t$ , i.e. it's a catch-all shock which mixes marginal cost and markup shocks  $\rightarrow$  marginal cost shocks stand in for demand shocks (which is absent in the model), and  $\mu_t$  is the cost-push shock. (Here a demand shock will have the same effect as a cost-push shock... mmm, I don't know if I like that...)

- $\mu_t \downarrow \rightarrow \eta_t \downarrow$
- $\pi_t \downarrow$
- If beliefs anchored,  $\mathbf{f}_k^{-1} \rightarrow 0$ , i.e. beliefs aren't allowed to fluctuate, so we stop here.
- If unanchored,  $\bar{\pi}_t \downarrow \rightarrow \pi_t \downarrow \dots$  Again, shock is amplified.

## 3 Questions

- Why is the discretion and 3-equation intuition not quite the same? Does ignoring beliefs make their amplification role more acute?
- Demand shocks?  $\rightarrow$  it seems to me to be a general thing that expectations (if based on RLS learning) amplify shocks, making stabilization more costly. But cost-push shocks seem special because of the tradeoff they introduce.
- Cost-push shocks as supply shocks? The issue of stabilization when shocks permanent (new steady state).

## 4 A problem

- Eusepi & Preston (2018, JEL): reevaluates optimal mon. pol in the NK model through the lens of learning. Bam. In particular: Result 5B. New tradeoff due to learning: policy today needs to respond more aggressively to inflation in order to limit future movements in expectations that would make the short-run tradeoff worse.