

Exam of the course “Monetary Economics”

Two hours. Course presentation slides allowed, in paper format, possibly with hand-written annotations. No other document allowed, nor any electronic device (calculator, mobile phone...).

1 Exercise (10 points)

The goal of this exercise is to study some positive and normative implications of price stickiness à la Taylor (rather than à la Calvo). To that aim, we make the same assumptions as in Chapter 1 of the course, except that :

- for simplicity, we remove cost-push shocks, i.e. we set $\varepsilon_t = \varepsilon$;
- for simplicity, we assume constant returns to scale, i.e. we set $\alpha = 0$, so that the production function is $Y_t(i) = A_t N_t(i)$;
- we replace Calvo’s price-stickiness assumption by Taylor’s, i.e. we assume that : (i) at each date, a fraction $1/N$ of firms reset their prices, where N is an integer greater than or equal to two, and (ii) each price remains effective for exactly N dates.

We keep exactly the same notations as in the course. **You can answer any question even if you have not answered the previous questions : to do so, just use the results provided in the previous questions.**

Question 1 Explain very briefly why the IS equation

$$\tilde{y}_t = \mathbb{E}_t \{ \tilde{y}_{t+1} \} - \frac{1}{\sigma} (i_t - \mathbb{E}_t \{ \pi_{t+1} \} - r_t^n) \quad (1)$$

remains unchanged (one or two sentences are enough).

Question 2 Under Taylor’s price-stickiness assumption, a firm i resetting its price at date t chooses the price P_t^* that maximizes

$$\sum_{k=0}^{N-1} \mathbb{E}_t \{ Q_{t,t+k} [P_t^* Y_{t+k|t} - \Psi_{t+k}(Y_{t+k|t})] \}$$

subject to $Y_{t+k|t} = \left(\frac{P_t^*}{P_{t+k}} \right)^{-\varepsilon} C_{t+k}$. Comment very briefly upon the differences between this optimization problem and the one obtained under Calvo’s price-stickiness assumption (one or two sentences are enough).

Question 3 Show that the first-order condition of this optimization problem is

$$\sum_{k=0}^{N-1} \mathbb{E}_t \{ Q_{t,t+k} Y_{t+k|t} (P_t^* - \mathcal{M}\psi_{t+k|t}) \} = 0,$$

where $\psi_{t+k|t} \equiv \Psi'_{t+k}(Y_{t+k|t})$ denotes the nominal marginal cost at $t+k$ for a firm that last reset its price at t , and $\mathcal{M} \equiv \frac{\varepsilon}{\varepsilon-1}$.

Question 4 Log-linearize this first-order condition around the zero-inflation-rate steady state (ZIRSS) and get

$$p_t^* = \mu + \frac{1-\beta}{1-\beta^N} \sum_{k=0}^{N-1} \beta^k \mathbb{E}_t \{ \psi_{t+k|t} \},$$

where $\mu \equiv \log \mathcal{M}$. Show that in the specific case where $\beta = 1$, this equation becomes

$$p_t^* = \mu + \frac{1}{N} \sum_{k=0}^{N-1} \mathbb{E}_t \{ \psi_{t+k|t} \}.$$

Comment very briefly on the differences between this equation and the one obtained under Calvo's price-stickiness assumption (one or two sentences are enough).

Question 5 Log-linearize the definition of the aggregate price index $P_t \equiv [\int_0^1 P_t(i)^{1-\varepsilon} di]^{\frac{1}{1-\varepsilon}}$ around the ZIRSS and get

$$p_t = \frac{1}{N} \sum_{k=0}^{N-1} p_{t-k}^* \tag{2}$$

Question 6 Using notably the labor-consumption trade-off condition, the goods-market-clearing condition, and the aggregate production function, show that $\psi_{t+k|t} = p_{t+k} + (\sigma + \varphi)\tilde{y}_{t+k} - \mu$. Using this and the previous results, show that, in the particular case where $\beta = 1$ and $N = 2$, we have

$$p_t^* = \frac{1}{2}p_{t-1}^* + \frac{1}{2}\mathbb{E}_t\{p_{t+1}^*\} + (\sigma + \varphi)(\tilde{y}_t + \mathbb{E}_t\{\tilde{y}_{t+1}\}). \tag{3}$$

Question 7 In the case where $\beta = 1$ and $N = 2$, the behavior of the private sector is thus summarized by the IS equation (1), the relationship (2) with $N = 2$, the Phillips curve (3), and the identity $\pi_t \equiv p_t - p_{t-1}$. Consider the interest-rate rule $i_t = \phi \Delta p_t^*$ with $\phi \geq 0$. Without doing any computation, describe how you would proceed to determine the necessary and sufficient condition for this rule to ensure determinacy. It turns out that this condition is $\phi > 1$; comment very briefly on this condition.

Question 8 Under what condition is the natural allocation efficient? Can monetary policy achieve the natural allocation? Comment very briefly on the difference(s), if any, with the answers to these questions under Calvo's price-stickiness assumption.

2 Commentary (10 points)

Comment briefly, in the light of the course, upon the following excerpt from the speech entitled "How Long is Too Long? How High is Too High? : Managing Recent Inflation Developments within the FOMC's Monetary Policy Framework" made by R.K. Quarles – Federal Reserve governor – on October 20, 2021, and, in so doing, explain in particular how the New Keynesian framework : (i) can rationalize the maximum-employment and price-stability objectives of the Fed, their relative importance at a given date, and their importance across time horizons; (ii) can rationalize the emphasis laid by the Fed on the anchoring of inflation expectations; (iii) can provide an answer to the questions of for "how

long” the Fed should tolerate high inflation and “how high” an inflation rate the Fed should tolerate.

“[W]e are facing a situation now where inflation is high even though employment has yet to fully recover from the COVID event. In that case, according to the FOMC’s monetary policy framework, when [our maximum-employment and price-stability] objectives are not complementary, the Committee ‘takes into account the employment shortfalls and inflation deviations and the potentially different time horizons over which employment and inflation are projected to return to levels judged consistent with its mandate.’

Demand, augmented by unprecedented fiscal stimulus, has been outstripping a temporarily disrupted supply, leading to high inflation. (...) [W]e are discovering that it’s going to take more time than we had thought for supply to return to normal (...). If those dynamics should lead this ‘transitory’ inflation to continue too long, it could affect the planning of households and businesses and unanchor their inflation expectations. (...) So the central question we have to answer is ‘How long is too long?’

I am among those who see a good chance that inflation will remain above 2 percent next year, but I am not quite ready to conclude that this ‘transitory’ period is already ‘too long.’ We haven’t yet met the more stringent tests for liftoff that we have laid out in forward guidance about the federal funds rate. Let me quote from the latest FOMC statement : Raising rates will not be appropriate ‘until labor market conditions have reached levels consistent with the Committee’s assessments of maximum employment and inflation has risen to 2 percent and is on track to moderately exceed 2 percent for some time.’ (...) Therefore, we will remain outcome based, waiting to see further improvements in employment and the evolution of inflation pressures in coming months. (...)

I said just now that the central question is ‘How long is too long?’ I am also keenly aware, however, that inflation of 4 percent or more certainly cannot be characterized as only ‘moderately’ above 2 percent, and thus we also have to deal with the question of ‘How high is too high?’ Moreover, the two questions are obviously related : we can tolerate inflation of 2.5 percent as supply returns to normal without dramatically affecting inflation expectations, for a much longer period than we can tolerate inflation of 4.5 percent. So, how high is too high ?”