

Macroeconomics A: EI056

Midterm exam

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1 General instructions

The exam consists of 4 questions. Section 2 has 3 short subquestions, and sections 3-4-5 require more thinking. The weight of each question in the grade is indicated, so you can allocate your time accordingly.

A good strategy is to first read through the questions, and then start with the easiest one before proceeding to the harder ones.

Short “bullet points” answers stressing the main points are fine, you don’t have to write long paragraphs.

Best of luck!

2 Short questions (25 % of grade)

2.1 Forward guidance in IS-TR

In class we saw the IS-TR model. IS reflects the good market. Output Y is high when the real interest rate (nominal interest rate i net of expected inflation π^e) is low, or when households’ wealth Ω is high (α and β are positive coefficients):

$$Y = -\alpha(i - \pi^e) + \beta\Omega$$

TR reflects the Taylor rule that sets the nominal interest rate as a function of a long run target \bar{i} , current inflation π , and output:

$$i = \bar{i} + \delta\pi + \lambda Y$$

Consider that the central bank has driven the interest rate as low as it can, for instance to a value zero (in the IS-TR diagram with Y on the horizontal axis and i on the vertical TR is flat). Faced with this situation, central banks have tried two things:

1. Forward guidance: communicate that you will accept some inflation in the future.
2. Asset purchases: purchases of assets (including risky ones) by the central bank.

How would you model these policies in the IS-TR diagram?

2.2 Solow residuals

In the real business cycle class we discussed the Solow residuals.

1. Explain how they are constructed.
2. They are often used as a measure of productivity. What motivates this?
3. Are there shortcomings with that view, and if so how can they be addressed?

2.3 Expectations in AS-AD

When discussing the AS-AD model we consider backward-looking expectations and rational expectations.

1. How do the two differ?
2. Consider a policy of permanently higher government spending in the AS-AD. What is the impact on output in the short and long run? How does it depend on the way expectations are formed?
3. Developing a complete understanding of the economy is costly for agents (think of the effort involved). With this in mind, would you expect a small increase in government spending to have a different effect than a large one?

4 Central bank contract with punishment (25 % of grade)

4.1 Policy under discretion

Consider the time inconsistency model. In period t output is given by the aggregate supply:

$$y_t = \pi_t - \pi_t^e$$

where y is output, π is inflation and π^e is expected inflation. For simplicity I normalize the natural output (the level reached when inflation is fully expected) to zero.

The loss function of the central bank is:

$$L_t = \frac{1}{2} \left[\lambda (y_t - k)^2 + (\pi_t)^2 \right]$$

where k is the target bias, as the central bank would like to reach a level of output higher than the natural rate).

We can show that (take this as given) that if the central bank takes expectations as a parameter it sets (the *disc* superscript denotes “discretion”):

$$\pi_t^{disc} = \frac{\lambda}{1 + \lambda} \pi_t^e + \frac{\lambda}{1 + \lambda} k$$

Show that if the bank operates under discretion and agents form their expectations rationally, we get:

$$\pi^{disc} = \lambda k$$

Briefly explain the intuition.

4.2 Two periods horizon

We now consider that there are two periods, t and $t + 1$. The central bank’s loss is a discounted value of the two period-specific losses:

$$\begin{aligned} \mathcal{L}_t &= L_t + \beta L_{t+1} \\ \mathcal{L}_t &= \frac{1}{2} \left[\lambda (y_t - k)^2 + (\pi_t)^2 \right] + \frac{\beta}{2} \left[\lambda (y_{t+1} - k)^2 + (\pi_{t+1})^2 \right] \end{aligned}$$

In the past, the central bank had always delivered inflation equal to π^* . Agents thus enter period t with their expectations set at this level, so we take $\pi_t^e = \pi^*$ as given.

At period t there is a new central bank president who decides whether or not to continue this policy.

- If she continues the past policy, she delivers $\pi_t = \pi_{t+1} = \pi^*$, then agents keep expecting π^* in all periods.
- If the central bank delivers a different inflation in period t , that is $\pi_t \neq \pi^*$, agents expect inflation to be $\pi_{t+1} = \pi^{disc}$ (derived above) for period $t + 1$. In other words, any failure by

the central bank to deliver on its promise triggers a change in expectation.

Consider that the central bank breaks its promise (we think later whether or not it should). What inflation does it choose in period $t + 1$, and in period t (Hint: use the analysis of the previous point)?

4.3 Gain and cost from breaking promises

We now consider the choice of the central bank at period t .

If it deviate from $\pi_t = \pi^*$, this gives it a utility gain in period t . This gain is (take this as given):

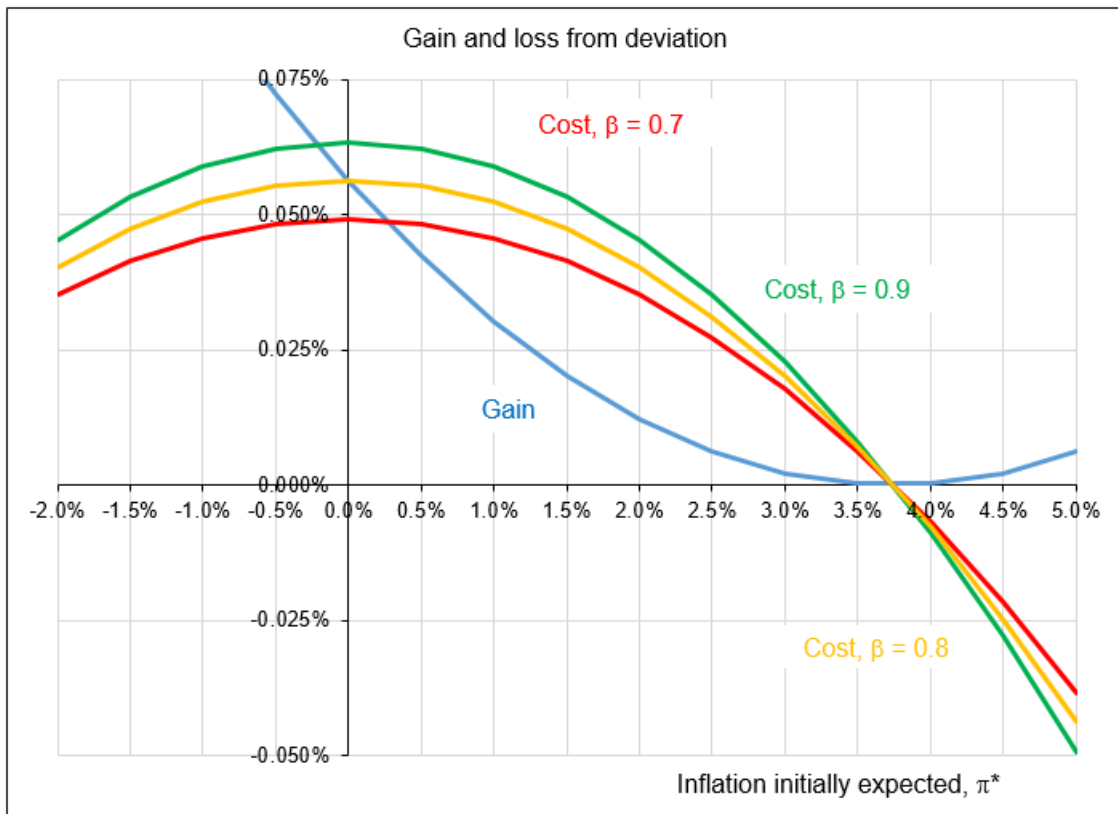
$$Gain(\pi^*) = \frac{1}{2} \left[\lambda (k)^2 + (\pi^*)^2 - \frac{\lambda}{1 + \lambda} (\pi^* + k)^2 \right]$$

As the deviation however triggers a change of expectations in period $t + 1$, the central bank faces a cost from having broken its promise. This cost is (take this as given):

$$Cost(\pi^*) = \frac{\beta}{2} \left[(\lambda k)^2 - (\pi^*)^2 \right]$$

The specific forms of $Gain(\pi^*)$ and $Cost(\pi^*)$ are given for reference. To make your work easier, we consider a numerical example. We set $\lambda = 0.25$, $k = 15\%$.

The figure below shows the gain and cost as functions of initial expectations π^* ranging from -2% to 5%. We show three calibrations of the cost: for $\beta = 0.7$ (red line), $\beta = 0.8$ (yellow line) and $\beta = 0.9$ (green line).



Based on this figure:

1. Explain the shape of the cost line in terms of intuition.
2. Explain the shape of the gain line in terms of intuition.
3. Explain what are the values of π^* (high, low) that the bank can credibly deliver.
4. Can we deliver zero inflation?
5. What is the highest inflation that the central bank can credibly deliver? Explain intuitively.
6. Can the central bank always deliver an inflation lower than the level under discretion?