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Economics 305

Midterm exam

October 31, 2013, 10.30-12.30

Instructions:
Answer all questions from Part I and exactly one question from part II.

Calculators are allowed.

Part I

For each statement, state whether it is true, false, or uncertain. Provide a *brief* explanation for each answer.

1. "The assumptions of real business cycle theory are far fetched and it only succeeds because it defines success so narrowly."

   Answer: There is some truth in this. What are the assumptions? They are that people are forward-looking optimizers when they choose how much to work and to consume from time to time and that technological progress is subject to imperfectly predictable disturbances. Perhaps this is implausible, but relative to what? Success is defined as matching some second moments (standard deviations and correlations) of the data; at least in the early literature, it does not aim to account for specific booms or recessions. That is a fair point. Perhaps we should be more ambitious.

2. "Hours worked are uncorrelated with output per hour. Therefore productivity shocks cannot be an important source of business cycle fluctuations."

   Answer: No, but it does imply that productivity shocks cannot be the *only* source of business cycle fluctuations. The key here is that productivity (technology) shocks give rise to a positive correlation between hours and output per hour. Other shocks such as government spending shocks give rise to a negative correlation. Both kinds of shocks are needed to fit the facts.

3. "The rapid inflation of the 1970s and 1980s was the work of cynical and short-sighted politicians."

   Answer. Not necessarily. It is possible that politicians were cynical and short-sighted in the 1970s and 1980s, but without an independent central bank with a mandate to target inflation, all it takes for there to be excess inflation is that politicians are benevolent and desire to push output and employment above the level implied by rational expectations.

4. "The U.S. Congress has established maximum employment and stable prices as the fundamental objectives of its central bank, the Federal Reserve. The Governor of the Bank of Canada and the Minister of Finance have agreed

that aiming for a 2 percent annual inflation rate should be the objective of Canadian monetary policy. We may conclude that Americans care more about employment than Canadians do."

Answer: Not at all. Enough influential Canadians accept the proposition that any attempt to use monetary policy to raise the average level of employment is futile. In the United States, the support for this proposition is not as strong.

Part II

1. Suppose output is determined according to

$$y = \pi - \pi^e + \varepsilon$$

where y is (log) output, π is the inflation rate, π^e is the expected rate of inflation and ε is a random shock with mean 0 and variance σ^2. Inflation expectations are formed before the monetary authority sets the inflation rate. Individuals in the private sector wants to be right; the (benevolent) monetary authority minimizes

$$\mathsf{E}\left[(y - \overline{y})^2 + \pi^2\right]$$

where $\overline{y} > 0$.

(a) Suppose nobody, neither the monetary authority nor the private sector knows the realized value of ε before they make their decisions. Find the equilibrium value of output and inflation. What is the variance of (log) output?

Answer: $\pi = \overline{y}$. Hence $y = \varepsilon$. The variance of output is σ^2.

(b) Suppose the private sector has no advance knowledge of the realized value of ε, but the monetary authority does. Find the equilibrium value of output and inflation. What is the variance of output?

Answer: See lecture notes for the derivation of the following result.

$$\pi = \overline{y} - \frac{1}{2}\varepsilon$$

$$y = \frac{1}{2}\varepsilon.$$

The variance of log output is therefore $\frac{1}{4}\sigma^2$.

(c) By how much is expected loss reduced as a result of the advance information obtained by the monetary authority?

Answer: The loss with no information is $2\overline{y}^2 + \sigma^2$. The loss with information is $2\overline{y}^2 + \frac{1}{2}\sigma^2$. Thus the loss reduction is $\frac{1}{2}\sigma^2$.

2. Consider an economy inhabited by households which consist of a worker and a shopper. The two separate each morning and the worker has to decide how much to work on the basis of observing the nominal wage only, which is the product of labour productivity z_t and the money supply M_t. We write

$$W_t = z_t M_t.$$

Labour is the only input so that the output of each worker is given by $y_t = z_t h_t$. The worker wants to "make hay while the sun shines", i.e. work harder when labour productivity z_t is above its mean. Specifically, she would like to set $\ln h_t = \ln z_t$, but this is not feasible since she doesn't observe z_t. Instead she minimizes mean square regret, i.e. she solves

$$\min_{\ln h} \mathsf{E}\left[(\ln h - \ln z)^2\right]$$

where we have suppressed the time subscripts. We assume that $\ln M$ and $\ln z$ are identically and independently distributed over time with mean $\mathsf{E}[\ln M] = \mathsf{E}[\ln z] = 0$ and variances $\mathsf{E}[(\ln M)^2] = \sigma^2_{\ln M}$ and $\mathsf{E}[(\ln z)^2] = \sigma^2_{\ln z}$. The two shocks are independent of each other so that $\mathsf{E}[\ln M \cdot \ln z] = 0$. It turns out that the optimal choice is given by $\ln h = b \ln W$ where

$$b = \frac{\sigma^2_{\ln z}}{\sigma^2_{\ln z} + \sigma^2_{\ln M}}.$$

(a) What is the economic reason for why b is a decreasing function of $\sigma^2_{\ln M}$?
Answer: As $\sigma^2_{\ln M}$ goes up, a larger fraction of the variation in the nominal wage is accounted for by fluctuations in the general price level—fluctuations that the worker does not want to respond to at all. So it seems logical that she should respond less to a shock of a given size as this fraction goes up.

(b) Find an expression for the variance of (log) output.
Answer:

$$\sigma^2_{\ln y} = (1+b)^2 \sigma^2_{\ln z} + b^2 \sigma^2_{\ln M} =$$

$$= \frac{4\sigma^4_{\ln z} + \sigma^4_{\ln M} + 4\sigma^2_{\ln z}\sigma^2_{\ln M}}{\left(\sigma^2_{\ln z} + \sigma^2_{\ln M}\right)^2} \cdot \sigma^2_{\ln z} + \left(\frac{\sigma^2_{\ln z}}{\sigma^2_{\ln z} + \sigma^2_{\ln M}}\right)^2 \cdot \sigma^2_{\ln M} =$$

$$= \frac{4\sigma^6_{\ln z} + \sigma^4_{\ln M}\sigma^2_{\ln z} + 5\sigma^4_{\ln z}\sigma^2_{\ln M}}{\left(\sigma^2_{\ln z} + \sigma^2_{\ln M}\right)^2}.$$

By the way, writing down the first row suffices for full marks.

(c) Verify, by computing a small number of numerical examples, or otherwise, that an increase in $\sigma^2_{\ln M}$ reduces the variance of output. Explain why this is so, or at least why it may be the case. Does it follow that it is beneficial to pursue an erratic monetary policy?

Answer: As $\sigma^2_{\ln M}$ goes from zero to infinity, the variance of log output goes from $4\sigma^2_{\ln z}$ to $\sigma^2_{\ln z}$. How can this be so? Well, unpredictable shocks to monetary policy, given that they are uncorrelated with technology, adds noise to the economy that people don't want to react to. In the limit, as $\sigma^2_{\ln M}$ goes to infinity, people don't react to technology shocks at all and the variance of log output is just the variance of technology.

In any case, erratic monetary policy is *not* beneficial. Hours *should* respond to technology shocks. Indeed, we would like $\ln h = \ln z$ in which case $\ln y = 2 \ln z$ and hence $\sigma^2_{\ln y} = 4\sigma^2_{\ln z}$. This desireable outcome is only achieved when $\sigma^2_{\ln M} = 0$.

Good luck!