Monetary Economics: Midsemester Exam

Due Tuesday October 7th in class

Remember, this exam is *optional*. If you don't take it or if you do better on the final exam it won't count. There are 100 points up for grabs. The points for each question are indicated below. Please contact me asap if you have any questions.

1. **Brief essay on new Keynesian economics** (50 points). Write a brief essay explaining the main successes and limitations of the new Keynesian approach to monetary economics as you see them. For example:

   – are the microfoundations of the new Keynesian model satisfactory?

   – does the new Keynesian model fit the data well?

   – are the policy recommendations of the new Keynesian model robust?

   – what are the most promising directions for future development?

   The list above is just to get you going. You are *not restricted* to discussing these issues nor do you *have* to discuss them, they're just to get you thinking.

   A few further pointers: Please take a broad-minded view of the material, don't focus on any particular version of the new Keynesian model, instead keep your attention on matters that are true (more or less) for the literature as a whole. You might like to begin by re-reading Gali (2008), chapter 1 for context. Please don't write more than 1500 words or I shall be forced to deduct points (4 points for every 100 words over, in case you're wondering).

2. **Policy tradeoffs in the new Keynesian model, once more** (50 points). Consider a new Keynesian model with output gap and inflation given by

$$\tilde{y}_t = -\frac{1}{\sigma}\left(i_t - \mathbb{E}_t[\pi_{t+1}] - \rho\right) + \mathbb{E}_t[\tilde{y}_{t+1}]$$

   and

$$\pi_t = \beta \mathbb{E}_t[\pi_{t+1}] + \kappa \tilde{y}_t + x_t$$

   with $\sigma, \kappa > 0$ and $0 < \beta < 1$. Monetary policy is given by the interest rate rule

$$i_t = \rho + \phi \pi_t + v_t$$

   with $\phi > 1$. The supply shock $\{x_t\}$ and monetary policy shock $\{v_t\}$ follow independent AR(1) processes, namely

$$x_{t+1} = \rho_x x_t + \varepsilon_{x,t+1}$$

and

$$v_{t+1} = \rho_v v_t + \varepsilon_{v,t+1}$$

with $0 \leq \rho_x, \rho_v < 1$ and where the innovations $\{\varepsilon_{x,t}\}$ and $\{\varepsilon_{v,t}\}$ are both IID normal with mean zero and standard deviations $\sigma_{\varepsilon x}$ and $\sigma_{\varepsilon v}$ respectively.

The central bank evaluates outcomes according to the equally-weighted loss function

$$L = \text{Var}[\pi_t] + \text{Var}[\tilde{y}_t]$$

where $\text{Var}[\pi_t]$ and $\text{Var}[\tilde{y}_t]$ denote the long-run (unconditional) variances of inflation and the output gap.

(a) Guess that equilibrium inflation and the output gap are linear in the shocks x_t, v_t with coefficients $\psi_{\pi x}, \psi_{\pi v}, \psi_{yx}, \psi_{yv}$. Use the method of undetermined coefficients to solve explicitly for these four coefficients in terms of the model parameters. Explain intuitively the effects of x_t and v_t on equilibrium inflation, the output gap, and nominal and real interest rates. (10 points)

Now suppose a quarterly model with the following specific *benchmark parameter values:* $\sigma = 1$, $\rho = .02$, $\beta = .98$, $\kappa = .1$, $\phi = 1.5$ and with AR(1) coefficients $\rho_x = \rho_v = .90$ and innovation standard deviations $\sigma_{\varepsilon x} = \sigma_{\varepsilon v} = .01$.

(b) Using these benchmark parameter values, calculate the four equilibrium coefficients from part (a) above. Now suppose at time $t = 0$ the economy is at steady-state. There is then a one-standard-deviation contractionary monetary policy shock, $v_1 = .01$ at time $t = 1$. Calculate and plot the impulse response functions of inflation, the output gap and nominal and real interest rates for 50 quarters after the shock. Give economic intuition for your results. Repeat this exercise but now assuming that there is a one-standard-deviation supply shock $x_1 = .01$ at time $t = 1$. Again calculate and plot the impulse response functions of inflation, the output gap and nominal and real interest rates for 100 quarters after the shock and give economic intuition for your results. (10 points)

(c) Now consider the optimal choice of the policy rule coefficient ϕ. For each

$$\phi \in \{1.01, 1.02, 1.03, ..., 10\}$$

calculate the equilibrium coefficients $\psi_{\pi x}(\phi), \psi_{\pi v}(\phi), \psi_{yx}(\phi), \psi_{yv}(\phi)$ (keeping all other parameters at their benchmark values). Use these coefficients to calculate and plot the unconditional variance of inflation, variance of the output gap, and central bank loss for each value of ϕ. What value of ϕ minimizes the central bank's loss function? Is the benchmark $\phi = 1.5$ optimal? Why or why not? (10 points)

(d) How do your results for part (c) change if instead $\kappa = .075$ or if $\kappa = .125$? What about if $\kappa = .5$? Give economic intuition for your results. Similarly, how do your results for part (c) change if instead $\sigma_{\varepsilon x} = .02$ or if instead $\sigma_{\varepsilon v} = .02$? (for these calculations put κ back to its benchmark value $\kappa = .1$)? Again, give economic intuition for your results. (5 points)

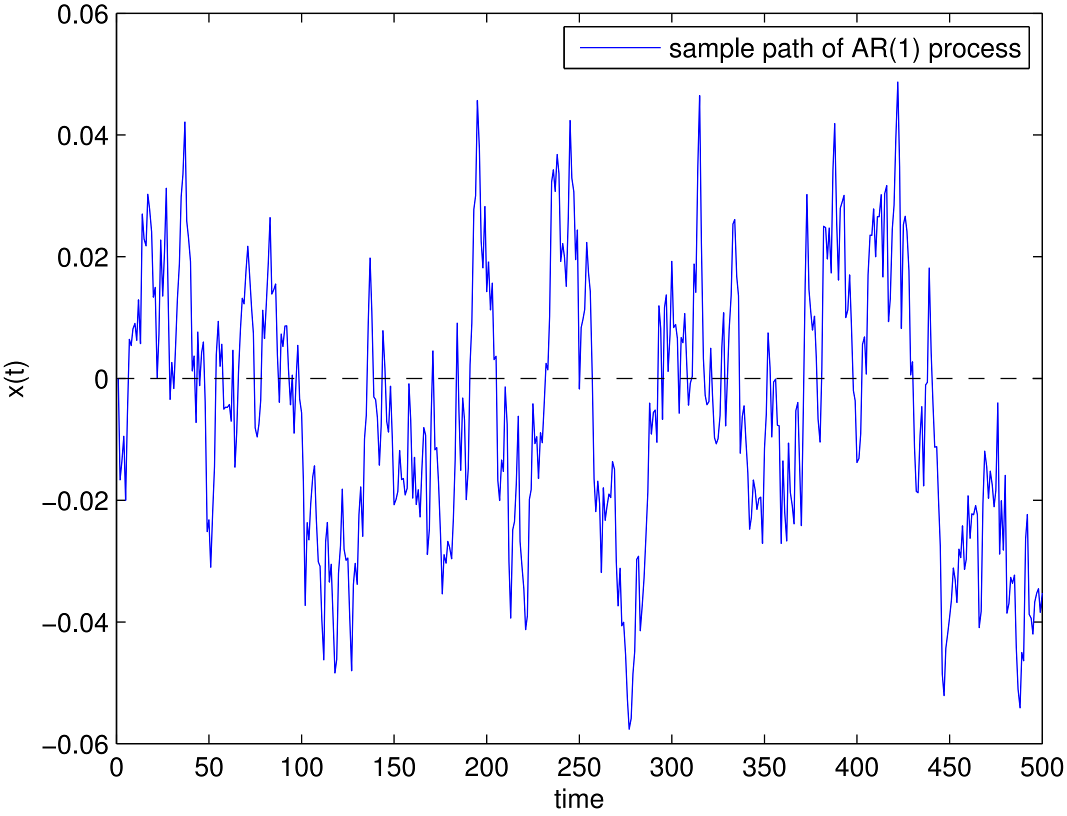
(e) Draw a sample of length 200 realizations of the innovations $\{\varepsilon_{x,t}, \varepsilon_{v,t}\}$. Starting from steady-state, use these draws to simulate time-series for the shocks $\{x_t, v_t\}$ and then use the shocks and the equilibrium coefficients to simulate inflation and the output gap and the nominal and real interest rates. Plot each of these simulated time-series. For this exercise put all parameters back to their benchmark values.

Now report the correlation matrix for the vector

$$\left[\, x_t \,,\, v_t \,,\, \pi_t \,,\, \tilde{y}_t \,\right]$$

Is there evidence of a reduced-form 'Phillips Curve' (aggregate supply) relationship in this simulated data? — i.e., would an economist looking at a simple scatterplot of inflation against the output gap find a 'Phillips Curve' relationship? How, if at all, do your results change if instead $\sigma_{\varepsilon x} = .1$ or if instead $\sigma_{\varepsilon v} = .1$? (keeping all other parameters at their benchmark values). Explain your findings. (15 points)

```
%%%%% Scrap of Matlab code to simulate AR(1)

clear all;
close all;

randn('state',0);    % reset seed of random number generator

%%%%% parameters

S       = 500; % length of simulation

rho_x   = 0.9;  % AR(1) coefficient (serial correlation)
sig_ex = 0.01; % innovation standard deviation

x0      = 0;    % initial condition


%%%%% draw S realizations from N(0,sig_ex^2)

ex      = sig_ex*randn(S,1);

%%%%% iteratively construct sample path

xt      = zeros(S,1);

for s=2:S,

xt(1)  = x0;
xt(s)  = rho_x*xt(s-1)+ex(s);

end

time = cumsum(ones(S,1));

figure(1)
plot(time,xt,'b-',time,zeros(S,1),'k--')
xlabel('time')
ylabel('x(t)')
legend('sample path of AR(1) process')
```


0.06
0.04
0.02
0
−0.02
−0.04
−0.06
x(t)
0
50
100
150
200
250
300
350
400
450
500
time
sample path of AR(1) process