New Economic School
Macroeconomics 2

Problem set 3

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Due on November 24th before sections

1. Recall problem 1 of the assignment 2. Using the AS-AD model of the lectures augmented with the expectations adjustment formula $P^e_{t+1} = P_t$, show the effects of improvements in monitoring on the position of the IS, LM, AD, and AS curves in the short, medium, and long term. Summarise the effects on output, interest rate, and the price level at all times.

2. Consider an economy characterized by the following aggregate demand equation:

$$y_t = m_t - p_t,$$

where m_t is the (log) money stock under control of the Fed, p_t is the price level, and y_t is output. *All* variables in this problem are in logs, so $y = \ln Y$, etc.

Assume that there are two groups of agents in the economy – miners and metal workers. Denote their wages by w^A_t and w^B_t, respectively. Also assume that wage contracts are written down for two years: so miners would renegotiate contracts in odd years, and metal workers – in even years. The wage of each group is set for the duration of the contract (2 years). The wage-setting equation is

$$w^X_t = w^X_{t+1} = p_t + \alpha y_t, \text{ where } X \in \{A, B\}$$

for the group that has a chance of negotiating its wage in year t (here $\alpha < 1$). Notice that workers setting wage at time t perfectly forecast the

price level at the beginning of year t – they use rational expectations. The price setting equation in the economy is

$$p_t = \frac{w_t^A + w_t^B}{2}$$

(a) Define a steady state: this is when $w_t^A = w_t^B$ and money stock is constant. Consider a steady state in which $m = 0$ (a pure normalization implying that the *level* of the money stock is 1). Characterize the steady state: what is the steady state level of output? What is the price level? What are nominal wages w^A, w^B? What are the real wages (notice that since we are working with logs, real wages are $\log\left(W^X/P\right)$)?

(b) Suppose that at time $t = 0$ the economy was at the steady state with $m = 0$. Assume that at time $t = 1$ money stock increases unexpectedly to $\bar{m} > 0$ and stays at that level forever. Rational workers know that the increase is going to be permanent.
Write down the wage-setting equation for the group of workers that can negotiate new contract at time 1 (notice that wages of the other group remain fixed for this year at their previous level!). Combine this with aggregate demand and price-setting to arrive at a closed-form solution for wages of both groups and price level at time 1 (w_t^A, w_t^B). What happened to output? How did real wages of both groups change? (A formula is required.)

(c) As time progresses and metal workers get a chance to renegotiate wages, what happens in period $t = 2$ to wages (nominal and real) of both groups? Check whether the wages of metal workers will be higher than miners' at $t = 2$. What will happen to the price level and the output (remember, $m_t \equiv \bar{m} > 0$)? Does the output return to its steady state level? Did the real wages catch up completely to their steady state levels?

(d) What will happen in years $t > 1$? Define w_t^L and w_t^F the wages of "leaders" and "followers", i.e. wages of those groups which respectively set the wage in year t and those who have set their wage at $t - 1$. Notice that

$$w_t^F = w_{t-1}^L$$

Provide a *recursive* formula for w_t^L for $t > 0$ (that means w_t^L as a function of w_{t-1}^L and $\bar{m}$ only).

(e) Check the expression for $m_t - w_t^L$. It is a function of $\left(m - w_{t-1}^L\right)$. Given that $\alpha < 1$, does it converge anywhere? What is the new steady state in this economy (y, p, w^X, real wages). What is the permanent effect of money on output compared to $t = 0$?

(f) We assumed that workers have rational expectations of prices. In fact, notice that they knew that the increase in prices is going to continue. What is responsible for the gradual adjustment of the economy to the steady state?

3. Interest parity conditions.

Consider the price schedule for government bonds and foreign exchange in the United States and Russia. Both government bonds are one-year securities. The current exchange rate e stands at \$0.2/1R (Russian currency is R for *rouble).*

Bond	Face Value	Price	Currency
US	10,000	9,708.74	US\$
Russia	100,000	61,349.69	*Rouble*

(a) Calculate the nominal interest rate on each of the bonds and the expected exchange rate next year consistent with Uncovered Interest Parity. Note whether this signifies an expected appreciation or depreciation of the *rouble.*

(b) Assume you exchange dollars for roubles and purchase the Russian bond, but one year from now it turns out that e is actually \$0.05/1R. What is your actual nominal return compared to the return if you had just purchased the US bond? Are these differences in returns consistent with arbitrage?

(c) Assume that there exists a market for buying and selling foreign exchange one-year in the future, but fixing the price of the transaction today. Denote the forward price of one rouble in terms of dollars by f. In other words, you can enter into a contract today to sell one rouble for f dollars one year in the future. Derive the following approximation to the Covered Interest Parity as stated below:

$$i_{US} = i_{RU} + \frac{(F - E)}{E}$$

(d) What is the forward price of 1 rouble consistent with Covered Interest Parity? Compare actual nominal returns between the two

strategies if next year e is actually 0.05 as above. Is Covered Interest Parity between the two 1-year bonds really riskless arbitrage?

Fiscal coordination.
Consider 2 adjacent economies which only trade with each other, described by the following equations (starred variables refer to the foreign country):

$C = 10 + 0.6\,(Y - T)$	$C^* = 5 + 0.3\,(Y^* - T^*)$
$G = 10$	$G^* = 5$
$T = 10$	$T^* = 10$
$Q = Y/10$	$Q^* = Y^*/10$
$X = 0.1Y^*$	$X^* = 0.1Y$

There is no investment. For this reason, assume also that there are no capital movements between these two countries. Assume also prices are fixed, as is the nominal exchange rate, hence we can normalise the real exchange rate at 1.

a) (points) Compute the equilibrium outputs in the two countries (you may assume that each country takes the other country's output as given, not taking into account the influence of imports on that). Compute the trade balance of each country.

b) (points) By how much should countries increase their spending G, G^*, to achieve target levels of output at 40 and 15, if they decided to act separately?

c) (points) What if the governments could coordinate their actions? Would your answer to b) change?