**311 Macroeconomics-Spring 2000, Prof. Larry Christiano**
**Solution to Homework 8**

## 1. Blanchard, page 414, Question 3

Under fixed exchange rates, the nominal exchange rate $E$ is exogenously given. To keep the nominal exchange rate fixed, the monetary authority adjusts the money supply so that the domestic interest rate, $i$, is always equal to the international interest rate $i^*$. The equilibrium is characterized by the following equations:

$$\begin{aligned} Y_t &= Y\left(\frac{EP^*}{P_t}, G, T\right) \text{ (AD), with } Y_1 > 0, Y_2 > 0, Y_3 < 0, \\ P_t &= P_{t-1}(1+\mu) F\left(1 - \frac{Y_t}{L}, z\right) \text{ (AS)}, \end{aligned}$$

where $Y_i$ is the derivative of aggregate domestic spending with respect to argument $i$.

1. Assume $G$ increases and the economy was originally at a medium run equilibrium point like $E_0$. This implies that the IS and AD curves shift right (see figure), to $IS_1$ and $AD_1$, respectively. For a constant price level, the economy is at point $E_1$. The increased domestic demand causes domestic prices to rise, generating a real appreciation of the domestic currency. This reduces demand for domestic goods. The IS curve shifts to $IS_2$ and the economy moves along $AD_1$ to the short run equilibrium $E_2$. The transition to the short run equilibrium to the new medium run equilibrium occurs via changes in price expectations. At $E_2$, $P_{t-1} = P_2 > P_1$, so that the AS curve shifts to $AS_1$, so on. As the price revel increases, the real exchange rate appreciates further, so that the IS curve shifts left, going back to $IS_0$ in the medium run.

2. In the short run, consumption increases and net exports decrease (we are asssuming that the Marshall-Lerner condition holds). In the medium run, consumption goes back to the original level and net exports decrease further. The effect on investment demand depends on output and on the real interest rate defined as:

   $$r = i - \pi^e,$$

   where $\pi^e = P^e_{t+1}/P_t - 1$ is the expected inflation rate. The model doesn't pin down $\pi^e$. Therefore, we assume that $\pi^e = 0$ (which is true in the medium

run) so that investment demand increases in the short run, since $Y$ increases, and goes back to the original level in the medium run.

3. An increase in government spending with fixed taxes causes an increase in the government deficit. In the medium run, with fixed exchange rates, this causes a decrease in next exports. Since investment demand and private savings are constant in the medium run, foreign borrowing has to increase to finance the additional government deficit. Increased foreign borrowing corresponds to lower net exports.

## 2. Blanchard, page 379, Question 4

1. Consider two open IS-LM economies. A tariff on imports increases the price imports, which will typically decrease the demand for imports:

$$Q\left(Y,\varepsilon,\tau\right),\ \text{with } Q_1>0,\ Q_2<0,\ Q_3<0,$$

where $\varepsilon$ is the real exchange rate and $\tau$ the tariff. One way to model this is:

$$Q=q_0+q_1Y-q_2\varepsilon\left(1+\tau\right),\ q_i>0 \text{ for } i=1,2,3. \tag{2.1}$$

The export relation would not be affected since it is given by foreign demand for domestic goods, on which no tariff is applied.

2. Equilibrium output solves the following condition in the domestic country:

$$Y=C+I+G+X\left(Y^*,\varepsilon\right)-Q\left(Y,\varepsilon,\tau\right).$$

For a given values of $Y^*$ and $\varepsilon$ demand for domestic goods will be higher. For example, from (2.1):

$$Y^e=\frac{c_0-c_1T+I+G+X-q_0+q_2\varepsilon\left(1+\tau\right)}{1-c_1+q_1}.$$

The effect on net exports, for given $Y^*$ and $\varepsilon$, depends on whether the direct effect of imposing the tariff dominates the indirect and opposite effect of increased domestic output. We assume the first effect is stronger, so that $NX$ increase in response to the tariff.

3. Demand for foreign goods will go down due to the tariff for a given value of $\varepsilon$, which will decrease equilibrium output in the foreign country. In addition, net exports will fall in the foreign country since:

$$NX^*=X^*\left(Y,\varepsilon,\tau\right)-\frac{1}{\varepsilon}Q^*\left(Y^*,\frac{1}{\varepsilon}\right),$$

and we assumed that $NX$ would increase in the domestic country due to a fall in $Q$.

4. If the foreign country retaliates by imposing a tariff, $\tau^*$, on imports of goods from the domestic country, the effect on output and net exports will be nil if the two countries are symmetric. The volume of trade between the two countries will go down, but the trade balance will be the same as with no tariffs in either country. However, output and net exports in the domestic country will be lower than in part *b.*, while output and net exports in the foreign country will be higher than in part *c.*

**An Algebraic Example**

Assume that the domestic and the foreign country are perfectly symmetric, and that the real exchange rate is fixed to one. Their goods market equilibrium conditions, without taxes on imports, are:

$$\begin{aligned} Y &= c_0 + c_1 (Y - T) + I + G + q_1 Y^* - q_1 Y \\ Y^* &= c_0 + c_1 (Y^* - T) + I + G + q_1 Y - q_1 Y^* \end{aligned}$$

The equilibrium levels of output are:

$$Y = Y^* = \frac{1}{1 - c_1} AE$$

where $AE = c_0 - c_1 T + I + G$. Net exports are obviously equal to zero for both countries.

A measure of the volume of trade is given by the sum of the exports of the two countries:

$$Trade = X + X^* = \frac{2q_1}{1 - c_1} AE$$

If the domestic country taxes import at rate $\tau$, then for each dollar spent on foreign goods only $(1 - \tau)$ are imported, and the remaining $\tau$ dollars go to the Government. This modifies the goods market equilibrium conditions as follows:

$$\begin{aligned} Y &= c_0 + c_1 (Y - T) + I + G + q_1 Y^* - q_1 (1 - \tau) Y \\ Y^* &= c_0 + c_1 (Y^* - T) + I + G + q_1 (1 - \tau) Y - q_1 Y^* \end{aligned}$$

Solving for the equilibrium levels of output, after some algebra, you can get the following result:

$$
\begin{aligned}
Y &= \left(\frac{1-c_1+2q_1}{1-c_1+2q_1-\tau q_1}\right)\frac{1}{1-c_1}AE \\
Y^* &= \left(\frac{1-c_1+2q_1-2\tau q_1}{1-c_1+2q_1-\tau q_1}\right)\frac{1}{1-c_1}AE
\end{aligned}
$$

Notice that the term in parenthesis in the expression for $Y$ is bigger than one, while the term in parenthesis in the expression for $Y^*$ is smaller than one.

Hence the introduction of a tax on imports increases the equilibrium level of output for the domestic country, and decreases the equilibrium level of output for the foreign country. The bigger is $\tau$, the larger is the difference between $Y$ and $Y^*$.

The net exports of the domestic country are now positive, and this is compensated by negative net exports of the foreign country:

$$
\begin{aligned}
NX &= \frac{\tau q_1}{1-c_1+2q_1-\tau q_1} \\
NX^* &= \frac{-\tau q_1}{1-c_1+2q_1-\tau q_1}
\end{aligned}
$$

If the foreign country retaliates, by imposing a tax on its imports at the same rate $\tau$, the equilibrium level of output is back to the case of zero taxes for both countries:

$$
\begin{aligned}
Y &= c_0 + c_1\left(Y-T\right) + I + G + q_1\left(1-\tau\right)Y^* - q_1\left(1-\tau\right)Y = \frac{1}{1-c_1}AE \\
Y^* &= c_0 + c_1\left(Y^*-T\right) + I + G + q_1\left(1-\tau\right)Y - q_1\left(1-\tau\right)Y^* = \frac{1}{1-c_1}AE
\end{aligned}
$$

Net exports are back to zero for both countries, but the volume of trade, as measured by the sum of the exports, is reduced:

$$
Trade = X + X^* = \frac{2q_1\left(1-\tau\right)}{1-c_1}AE
$$