14.02 Principles of Macroeconomics

Problem Set #3, solutions

Posted: Wednesday, October 13, 2003

Due Date: Wednesday, October 20, 2003

Part I: True/False

Decide whether each of the following statement is true or false, and justify your answer with a short argument.

1. The ratio of imports to GDP cannot be larger than 1.

    False: GDP is about value added, whereas imports (and exports) are about the total value of goods. A country can import $100 worth of intermediate goods, add $10 to the value of the goods and export them for a value of $110. If that is the only source of imports, and the only value added in this economy, the ration of imports to GDP will be 10, far more than 1.

2. If GM decides to use only French made Michelin tires for its cars instead of Firestone US made tires, the total demand for US goods decreases.

    True: the demand by US residents (GM) shifts from domestic goods towards foreign goods. Therefore the demand for domestic goods decreases.

3. An American tourist spends his holidays in Egypt. Once in Egypt, he pays $100 for his hotel, $50 for kebabs and a $50 statue of Nefertiti to bring back home for his mother. He generated $200 worth of exports from Egypt to the US.

    True: the sale of domestic goods and services to a foreign resident is counted as exports.

4. The Queen of England pays £500,000 to a US insurance company to insure her precious jewels. The jewels get stolen. The insurance (after a long legal procedure) reimburses the Queen £2 million. Thanks to the thief of the jewels of the crown, the British capital account has been increased by £1.5 million.

    False: the Queen of England has bought £500,000 worth of services which is counted in imports. The reimbursement is counted in capital flows. Therefore the capital account has increased by £2 million, and the current account has decreased by £500,000.

Part II: The Uncovered Interest Parity with transaction costs.

Consider the decision of a US investor to invest $100 in a US bond or in a Eurobond. The exchange rate between $ and €is denoted E (the price of one euro in dollars). The annual interest rate paid on US bonds is i and the annual interest paid on Eurobonds is i^*. The investor expects that the exchange rate will be unchanged next year, at E.

1. Derive the condition on i, i^* and E that must hold for the US investor to be indifferent between buying US bonds or Eurobonds (this is exactly the uncovered interest parity we saw in class with zero expected depreciation).

   There is no expected depreciation, so interest rate in both countries must be equal for the investor to be indifferent: $i = i^*$.

Now assume that in order to buy €s with $'s, the investor must pay a proportional fee f for each dollar changed. Conversely, if he wants to change back €s into $'s, he must again pay the same proportional fee f for each dollar changed (or we could say equivalently that he must pay a proportional fee $E^*f/E=f$ for each euro changed).

2. How many dollars will the US investor get next year if he puts all his $100 in a US bond this year?

   He will get the face value plus the interest rate payment: $100*(1 + i)$.

3. How many euros will the investor get if he changes his $100 for euros today (remember, he has to pay a fee f for each dollar exchanged)?

   He will get €$100(1 – f)/E$ from his $100.

4. How many euros will he get next year if he uses all the euros he has to buy a Eurobond?

   He will get the face value plus the interest payment: €$100(1 – f)(1 + i^*)/E$.

5. How many dollars will the investor get next year if he changes back his euros for dollars (remember, the exchange rate has remained the same, but he has to pay a fee again).

   He will get $100(1 – f)^2(1 + i^*)E/E = $100(1 – f)^2(1 + i^*)$.

6. Give the condition on I, i^*, f and E that must hold for the US investor to be indifferent between buying a US bond or a Eurobond.

   He must get the same amount of dollars next year from each strategy:
   $$1 + i = (1 – f)^2(1 + i^*)$$

2

Notice that the exchange rate does not appear in the expression because the expected depreciation is equal to zero.

7. **Trick question:** consider a European investor who must decide between investing his €100 in Eurobonds or in US bonds. He must pay the same proportional fee f for changing euros against dollars or dollars against euros. If the condition in sub-question 6 is satisfied, is he indifferent between investing in Europe or in the US, or does he want to put all his money in Eurobonds, in US bonds?

Following the same reasoning, we can say that if he invests in Europe, he would get €100(1 + i*) while if he invests in the US, he would get €100(1 – f)²(1 + i). If the condition in sub-question 6 holds, 1 + i = (1 – f)²(1 + i*), then

$$€100(1 + i^*) = €100(1 + i)/(1 – f)^2 > €100(1 – f)^2(1 + i)$$

He is better off investing his money in Europe.

In a world with transaction costs, the interest parity condition no longer has to hold. The condition needed to prevent gigantic movements in capital accounts becomes:

$$1/(1 – f)^2 < (1 + i)/(1 + i^*) < (1 – f)^2.$$

If we take a first order approximation of this condition, is becomes:

$$|i – i^*| < 2f$$

In words, it means that the difference between the returns on bonds in each country cannot exceed the transaction cost: since one has to pay \$2f for every dollar changed (the fee for converting dollars to euros plus the fee to convert euros back into dollars), the transaction cost is 2f. If this condition is satisfied, US investors invest only in the US, and European investors invest only in Europe.

Part III: the goods market in an open economy. What is the impact of openness on the Keynesian multiplier?

We consider the following open economy model. Consumption and investment are given by:

$$C = c_0 + c_1(Y – T)$$

$$I = d_0 + d_1Y – d_2i$$

Imports are given by:

$$IM = m_1Y$$

All the parameters are positive, and $c_1 + d_1 - m_1 < 1$. We assume for simplicity that the real exchange is equal to 1. Government spending, G, exports, X, and the interest rate, i, are exogenous.

1. What is the total demand for domestic goods?

The total demand for domestic goods is:

$$Z = C + I + G - IM + X$$

2. What is the equilibrium level of output in this economy?

The equilibrium level of output in this economy is derived from the equilibrium in the goods market, demand equal supply:

$$Y = C + I + G - IM + X$$
$$Y = c_0 + c_1(Y - T) + d_0 + d_1Y - d_2i - m_1Y + X$$
$$Y = 1/(1 - c_1 - d_1 + m_1) * (c_0 + d_0 + G - c_1T - d_2i + X)$$

3. What is the balance of trade at that level of output?

The balance of trade at that level of output is given by:

$$X - IM = X - m_1/(1 - c_1 - d_1 + m_1) * (c_0 + d_0 + G - c_1T - d_2i + X)$$

4. What is the effect on equilibrium output of an increase of government spending of 1 unit? What is the effect on the trade balance?

An increase of government spending of 1 unit increases equilibrium output by $1/(1 - c_1 - d_1 + m_1)$ units, which is the open economy multiplier. It increases trade deficit (reduces trade balance) by $m_1/(1 - c_1 - d_1 + m_1)$ units, which is the increment in the demand for foreign goods triggered by the increase in GDP.

5. What is the Keynesian multiplier?

The Keynesian multiplier is defined as the effect of an increase of government spending on output. It is therefore equal to $1/(1 - c_1 - d_1 + m_1)$.

6. If the economy becomes more open, in the sense that m_1 increases, does the Keynesian multiplier increase, decrease, or stays unchanged?

As the economy becomes more open, the effect of an increase in government spending falls more and more heavily on foreign goods, meaning that the effect on the local output is more and more diluted (there is a leak in the system). The Keynesian multiplier decreases, as can be seen mathematically from the actual formula.

7. Now assume that $X = m_2 Y^*$ where Y^* is the foreign output. What is the effect of a foreign expansion (an increase in Y^*) on the domestic output? On the balance of trade?

We can rewrite the equilibrium output:

$$Y = 1/(1 - c_1 - d_1 + m_1) * (c_0 + d_0 + G - c_1 T - d_2 i + m_2 Y^*)$$

From that we see that a foreign expansion has a positive effect on domestic output. An increase of foreign output by 1 unit leads to an expansion at home of $m_2/(1 - c_1 - d_1 + m_1)$ units.

$$X - IM = m_2 Y^* - m_1/(1 - c_1 - d_1 + m_1) * (c_0 + d_0 + G - c_1 T - d_2 i + m_2 Y^*)$$

There are two effects on the trade balance: on the one hand, foreigner are richer, they want to buy more of our goods. On the other hand, this increase in the demand for domestic goods increases our output and therefore increases our own demand for foreign goods, which dampens the first effect. The overall trade increases. Our trade balance improves, but not as much as it would if the expansion abroad had no effect on domestic output.
An increase in foreign output of one unit leads to an increase in the trade balance of $m_2(1 - m_1/(1 - c_1 - d_1 + m_1)) > 0$ (check the condition on the parameters for that quantity to be positive and make sure you understand the reason why it cannot be negative).