

HOMework #7 Answer Key

Question 1

Please see the Aplia course site for suggested answers to this Aplia problem.

Question 2

(Mankiw Chapter 3 Problem 6, on page 60).

The following table describes the production possibilities of two cities in the country of Baseballia:

	Pairs of Red Socks per Worker per Hour	Pairs of White Socks per Worker per Hour
Boston	3	3
Chicago	2	1

(a) Without trade, what is the price of white socks (in terms of red socks) in Boston? What is the price in Chicago?

From the table we see that 1 worker-hour (1 worker working for 1 hour) employed in the production of white socks is necessary to produce 3 pairs of white socks in Boston. If this worker-hour was employed instead in producing red socks, exactly 3 pairs of red socks would be produced. Thus the price of 3 pairs of white socks is just 3 pairs of red socks -- or equivalently -- the price of one pair of white socks is one pair of red socks.

Similarly, in Chicago, freeing up 1 worker-hour from producing 1 pair of white socks and employing it instead in red socks production, 2 pairs of red socks can be produced. Thus, the price of 1 pair of white socks is 2 pairs of red socks, or equivalently, the price of a pair of white socks is two pairs of red socks.

Note that the price reflects the *opportunity cost* of worker-hours spent in the production of the types of socks.

**(b) Which city has an absolute advantage in the production of each color sock?
Which city has a comparative advantage in the production of each color sock?**

Recall that a city has an *absolute advantage* over another in the production of a good if it can produce the same good with fewer resources than the other country. A city has a *comparative advantage* in the production of a good over another city if it has a lower opportunity cost in its production relative to the other city.

To produce 1 pair of red socks, Boston requires $1/3$ worker-hours whereas Chicago needs $1/2$ worker hours. Thus Boston has an absolute advantage in the production of red socks since it needs fewer worker-hours per pair.

Similarly, Boston also has an absolute advantage in the production of white socks since it needs fewer worker-hours per pair of white socks ($1/3$ to 1).

From part (a) above, we see that the opportunity cost of producing a pair of white socks is higher in Chicago than in Boston. Thus Boston has a comparative advantage in white socks production (give up only 1 pair of red socks as opposed to 2 pairs for Chicago). Chicago has a comparative advantage in red socks production (give up $1/2$ pair of white socks as opposed to 1 pair for Boston).

Note: the comparative advantage result differing across cities is not an accident. In a two-good, two-city case, if one city has a comparative advantage over another in the production of one good, it necessarily means that the other city has a comparative advantage in the production of the other good.

(c) If the cities trade with each other, which color sock will each export?

When opened up to trade, each city will specialize in the production of the good in whose production it has a comparative advantage, and will export that same good. Thus Boston will export white socks and Chicago will export red socks.

(d) What is the range of prices at which trade can occur?

A city will remain no worse-off from trade if its *terms of trade* (the ratio of the price of the exported good to the price of the imported good) are higher than or equal to the ratio of the domestic prices of the same two goods before opening up to trade. If the terms of trade do **not** meet this condition for **either or both** of a pair of cities, the city for which this is not met will prefer not to trade since it will be better off without trade. In such a situation, mutually agreeable trade cannot take place.

Therefore, Boston – who will export white socks -- will only agree to trade if the price of white socks is more than or equal to 1 pair of red socks. Similarly, Chicago – who will import white socks – will only agree to trade if the price of white socks is less than or equal to 2 pairs of red socks. Thus, the range of prices at which trade can occur is when the price of a pair of white socks is between 1 and 2 pairs of red socks inclusive, ie. 1 pair red socks \leq price of 1 pair white socks \leq 2 pairs red socks.

Question 3

Suppose that in a year an American worker can produce 100 shirts or 20 computers, while a Chinese worker can produce 100 shirts or 10 computers.

Similar to question 2, we can describe the production possibilities of the Americans and the Chinese in a table:

	Shirts per Worker per Year	Computers per Worker per Year
US	100	20
China	100	10

(a) In America, what is the opportunity cost of producing an additional shirt (measured in terms of foregone computers)? In China, what is the opportunity cost of producing an additional shirt (measured again in terms of foregone computers)?

Following the logic presented in the answer to 2(a) above, we find that an additional shirt in America costs $1/100$ worker-years (1 worker working for 1 year), and freeing up the necessary $1/100$ worker-years in America would mean $(1/100 * 20) = 0.2$ fewer computers produced. Therefore the relevant opportunity cost is 0.2 computers.

Similarly, in China, an additional shirt also costs $1/100$ worker-years that would have to come at the expense of the production of $(1/100 * 10) = 0.1$ fewer computers. Thus the relevant opportunity cost in China is 0.1 computers.

(b) Suppose that America and China each have 100 workers. If each country devotes half its workers to each industry, how many shirts and computers does each country produce? What is world output of shirts and computers?

Devoting half of 100 workers to work in each industry, each country will have 50 worker-years in either industry over a year. From the table it is clear that this would mean:

Americans produce $50 \cdot 100 = \underline{5,000 \text{ shirts}}$ and $50 \cdot 20 = \underline{1,000 \text{ computers}}$
The Chinese produce $50 \cdot 100 = \underline{5,000 \text{ shirts}}$ and $50 \cdot 10 = \underline{500 \text{ computers}}$

World output is thus $5,000 + 5,000 = \underline{10,000 \text{ shirts}}$ and $1,000 + 500 = \underline{1,500 \text{ computers}}$.

(c) Suppose now that each country specializes by devoting all of its workers to the industry in which it has a comparative advantage. In this case, what is world output of shirts and computers?

From (a) above, we note that China has a comparative advantage in shirt production (to get an additional shirt, China needs to give up a fewer number of computers than America). America then must have a comparative advantage in producing the other good, ie. computers. Thus China specializes in shirt production while the US specializes in computer production.

With 100 worker-years in computer production, Americans produce $100 \cdot 20 = \underline{2,000 \text{ computers}}$.

With 100 worker-years in shirt production, China produces $100 \cdot 100 = \underline{10,000 \text{ shirts}}$

World output is therefore $\underline{10,000 \text{ shirts}}$ and $\underline{2,000 \text{ computers}}$.

Thus we see that world production has not fallen in either industry. Rather, world shirt production has stayed the same while world computer production has actually increased, meaning in total the world now produces more.

(d) Now allow American and China to trade with each other. Find a mutually agreeable trade that makes each country better off than it was before it specialized. What are the terms of trade?

We saw in 2(d) that trade can only feasibly occur if the terms of trade (the ratio of the price of the exported good to the price of the imported good) must be higher than or equal to the ratio of the domestic prices of the same two goods before opening up to trade.

Therefore in this question, we know from part (a) above the relevant range of prices at which mutually agreeable trade can occur is if the price of a shirt is between $1/5$ and $1/10$ computers inclusive, ie.

$0.1 \text{ computer} \leq \text{price of 1 shirt} \leq 0.2 \text{ computers}$. However, because this question requires each country to be *better off* (instead of just no worse off), we need to exclude the two boundary prices and the inequalities become $<$ instead of \leq , ie. we will require $0.1 \text{ computer} < \text{price of 1 shirt} < 0.2 \text{ computers}$.

The question asks for “a” mutually agreeable trade, so a range of answers are possible here. I explain in words one possibility and add another two in a table below:

Example: Suppose the terms of trade are 1 shirt = 0.15 computers (within the range above):

China specializes in shirts and produces 10,000 shirts and no computers.
Suppose she exports 5,000 of them to the US.
In return, she then imports $(0.15 \cdot 5,000) = 750$ computers from the US.

\therefore China produces (10,000 shirts, 0 computers)
China consumes (5,000 shirts, 750 computers).

The US -- on the other hand -- specializes in computer production, thus produces 0 shirts and 2,000 computers.

If she exports 750 computers to China, she gets 5000 shirts at the current terms of trade. This means she has $(2000 - 750) = 1250$ computers left to consume domestically.

\therefore The US produces (0 shirts, 2,000 computers)
The US consumes (5,000 shirts, 1,250 computers).

Thus both China and the US are better off than before they specialized, since, recalling from (b) above, the *autarky* (no trade) production and consumption bundles were:

China (5,000 shirts, 500 computers)	\leftarrow note the fewer number of computers
US (5,000 shirts, 1,000 computers)	\leftarrow note the fewer number of computers

The following table shows the possibilities for two other terms of trade.

Note: the first term in parentheses is always shirts in the table below, and the terms of trade is always presented as the price of computers relative to the price of shirts. Also, in the table below, I have always assumed that China exports exactly 5,000 shirts, this need not necessarily be the case.

	Terms of trade		
	0.11	0.15	0.19
US autarky production = US autarky consumption	(5000, 1000)	(5000, 1000)	(5000, 1000)
US specialized production	(0, 2000)	(0, 2000)	(0, 2000)
US trade	(5000, -550)	(5000, -750)	(5000, -950)
US consumption after trade	(5000, 1450)	(5000, 1250)	(5000, 1050)
China autarky production = China autarky consumption	(5000, 750)	(5000, 750)	(5000, 750)
China specialized production	(10000,0)	(10000,0)	(10000,0)
China trade	(-5000, 550)	(-5000, 750)	(-5000, 950)
China consumption after trade	(5000, 550)	(5000, 500)	(5000, 950)

Note also that as the terms of trade approach the autarkic price ratio for the US (ie. 1/5 or 0.20), the relative gains from trade is smaller for the US than for China. Conversely, when the terms of trade approach the Chinese autarkic price ratio (ie. 1/10 or 0.10), the relative gains from trade is smaller for China than for the US. This can be seen most easily by comparing the consumptions of computers for each of the countries before and after trade.

(e) Suppose that productivity in the Chinese computer industry increases to the point where a Chinese worker can produce 20 computers per year. In this case, are there any gains from trade between American and China? Explain.

No, this is the limiting case where neither country has a comparative advantage in the production of either good. With trade in such a case, neither country is strictly better off, although neither country will be quite worse off after trade either. More complex economic models can show how countries may still benefit from trade if a shirts and/or computers are not identical for the US and China and the consumers in either country / both countries have taste for variety. This, however, is beyond the scope of an intro course.

Question 4**(Mankiw Chapter 18 Problem 1, on page 408).****How would the following transactions affect U.S. exports, imports, and net exports?**

	US exports	US imports	US net exports
a. An American art professor spends the summer touring museums in Europe.	No change	+	-
b. Students in Paris flock to see the latest movie from Hollywood.	+	No change	+
c. Your uncle buys a new Volvo.	No change	+	-
d. The student bookstore at Oxford University sells a pair of Levi's 501 jeans.	+	No change	+
e. A Canadian citizen shops at a store in northern Vermont to avoid Canadian sales taxes.	+	No change	+

(Mankiw Chapter 18 Problem 2, on page 408).**Would each of the following transactions be included in net exports or net capital outflow? Be sure to say whether it would represent an increase or a decrease in that variable.**

	US Net exports	US Net capital outflow
a. An American buys a Sony TV.	Falls because imports rise	No change
b. An American buys a share of Sony stock.	No change	Rises because capital flows out of the US
c. The Sony pension fund buys a bond from the U.S. Treasury.	No change	Falls because capital flows into the US
d. A worker at Sony buys some Georgia peaches from an American farmer.	Rises because exports increase	No change

(Mankiw Chapter 18 Problem 6, on page 408).

Holding national saving constant, does an increase in net capital outflow increase, decrease, or have no effect on a country's accumulation of domestic capital?

Recall that we can rearrange the equation for national income determination to give us the equation in terms of national saving. Starting from:

$$Y = C + I + G + NX$$

Subtracting C and G from both sides, and both adding and subtracting T to the left hand side, we get:

$$\underbrace{(Y-T-C) + (T-G)} = I + NX$$

National saving

The term on the left hand side is national saving, ie. the sum of private saving and government saving (the two terms in parentheses, respectively).

Also, we saw in slide 12 on Lecture 7 that a trade deficit is a net capital inflow whereas a trade surplus is a net capital outflow.

Thus, leaving national saving unchanged, if net capital outflow increases, it means the trade balance would be going into more surplus, that is, Net Exports (NX) would be becoming more positive, ie. NX would rise.

If I remained constant as well as the left hand side, this would mean the two sides of the equation would no longer be equal but the right hand would be larger than the left hand side. Therefore, for the equality to hold, I cannot remain unchanged but must fall. In fact, I would fall by exactly enough to offset the rise in NX, so that the sum of both terms, in equilibrium, remains exactly what it had been before the rise in capital outflow.

Because I measures the country's accumulation of domestic capital, a resultant fall in I would mean the country's accumulation of domestic capital would decrease.

Question 5

(a) Read the article from The Economist (located on the course web site) about the Big Mac index.

Full credit for having read the article 😊.

(b) Suppose that 1 dollar is currently worth 10 yuan and 0.7 euros. How much is 1 euro worth in terms of yuan? How much is 1 yuan worth in terms of euros?

1 USD = 10 RMB (yuan) and 1 USD = 0.7 EUR

1 EUR = 1 EUR * (1 USD/0.7 EUR) * (10 RMB / 1 USD) = 10/0.7 RMB = 14.29 RMB.

So, the exchange rate is 14.29 RMB/EUR.

Equivalently, we could have written the exchange rate in terms of yuan:

1 RMB = 1/14.29 EUR, or 0.07 EUR/RMB.

Note: these are nominal exchange rates, a quick check is to make sure that the final units make sense, ie. in this question we need EUR/RMB.

(c) Suppose that a Big Mac costs 1.5 dollars in the U.S., 18 yuan in China, and 1.2 euros in Europe. Using these prices and the nominal exchange rates in part (b), calculate the real exchange rates (i.e., the rate at which Big Macs in one country can be exchanged for Big Macs in another country) for each of the three pairs of countries. For which, if any, pairs of countries does purchasing power parity (PPP) hold?

Big mac prices: 1.5 USD in US; 18 RMB in China; 1.2 EUR in Europe.

Real exchange rate or RER = eP/P^* , where:

e is the nominal exchange rate in terms of the home currency

P is the local price level (here just the local price of the Big Mac)

P* is the foreign price level (again, here just the foreign price of Big Mac).

Note: It is important to keep track of the units when computing exchange rates. As an easy rule of thumb, if e is foreign currency per home currency, then e would be units of foreign good per units of home good.

For each pair below, the second country denotes the home country.

i) CHN - USA:

$$\epsilon = \text{RER} = eP/P^* = (10 \text{ RMB/USD}) * (1.5 \text{ USD}) / (18 \text{ RMB})$$

= 0.833 Chinese Big Macs per US Big Mac or 1.20 US Big Macs per Chinese Big Macs

ii) EUR - USA:

$$\epsilon = \text{RER} = 0.7 \text{ EUR/USD} * 1.5 \text{ USD} / 1.2 \text{ EUR}$$

= 0.875 European Big Macs per US Big Mac or 1.14 US Big Macs per European Big Mac

iii) CHN - EUR:

$$\epsilon = \text{RER} = 14.29 \text{ RMB/EUR} * 1.2 \text{ EUR} / 18 \text{ RMB}$$

= 0.953 Chinese Big Macs per European Big Mac or 1.05 European Big Macs per Chinese Big Mac

Thus, PPP does not hold exactly for any because the RER differs from 1 in all of these.

(d) For each pair of countries, use the Big Mac prices to compute the nominal exchange rate predicted by PPP.

Assume PPP holds. Then $\text{RER} = 1$ for each pair.

Again, the second country in pair is the home country.

i) CHN - USA:

$$1 = e * 1.5 \text{ USD} / 18 \text{ RMB} \implies e = \underline{12 \text{ RMB/USD}}$$

ii) EUR - USA:

$$1 = e * 1.5 \text{ USD} / 1.2 \text{ EUR} \implies e = \underline{0.8 \text{ EUR/USD}}$$

iii) CHN - EUR:

$$1 = e * 1.2 \text{ EUR} / 18 \text{ RMB} \implies e = \underline{15 \text{ RMB/EUR}}$$

(e) If the PPP nominal exchange rates that you computed in part (d) do not agree with the actual nominal exchange rates in part (b), then state (for each pair of countries for which PPP does not hold) which country's currency must appreciate in order for PPP to hold.

Comparing the actual exchange rates computed in part (b) and the exchange rates predicted by PPP as calculated in part (d), we can tell which currency will appreciate in the long-run according to PPP theory.

If the actual rate is lower than the predicted exchange rate, then the home currency is the one that must appreciate according to PPP (remember that the exchange rate is given in terms of the home currency and that the second country in the pair is assumed to be the home country).

For example, if the actual nominal exchange rate is 10 RMB/USD and the predicted rate is 12 RMB/USD, then the actual exchange rate would mean that a Chinese merchant would have to give up 10 RMB to get 1 USD, but the predicted rate would mean the same merchant would have to now give up 12 RMB for that same 1 USD, hence to achieve the predicted rate, the value of the USD vis-à-vis the RMB would have to rise, ie. the USD would have to *appreciate* vis-à-vis the RMB.

Pair	Actual nominal exchange rate	Predicted nominal exchange rate (PPP)	Currency that must appreciate
CHN – USA	10 RMB/USD	12 RMB/USD	USD
EUR – USA	0.7 EUR/USD	0.8 EUR/USD	USD
CHN – EUR	14.29 RMB/EUR	15 RMB/EUR	EUR