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International Macroeconomics

1 Balance of Payments

Almost all the economies are **open economies** and have interactions in trade and finance with other countries. These interactions are documented in the **balance of payment account** which records the country's trade with other countries in goods, services and assets. The balance of payments consists of three accounts: the *current account*, the *financial account*, and the *capital account*. The next table shows the balance of payments for the U.S. in 2005. All the values are in millions of dollars.

Balance of Payments, U.S. 2005

Line	Current account		% of GDP
1	**Exports of goods and services and income receipts**	**1,749,892**	14.05%
2	Exports of goods and services	1,275,245	10.24%
3	Income receipts	474,647	3.81%
4	**Imports of goods and services and income payments**	**-2,455,328**	-19.71%
5	Imports of goods and services	-1,991,975	-15.99%
6	Income payments	-463,353	-3.72%
7	**Unilateral current transfers, net**	**-86,072**	-0.69%
8	Trade Balance (lines 2+5)	-716,730	-5.75%
9	Balance on current account (lines 1+4+7)	-791,508	-6.35%
	Capital Account		
10	**Capital account transactions, net**	**-4,351**	-0.03%
	Financial Account		
11	U.S.-owned assets abroad	-426,801	-3.43%
12	Foreign-owned assets in the United States	1,212,250	9.73%
13	Balance on Financial Account	785,449	6.31%
14	Statistical discrepancy (lines 9+10+13 with sign reversed)	10,410	0.08%

The **current account** records the country's exports and imports as well as income from investment and unilateral transfers. Any payments received by U.S. residents are positive numbers and any payments made by the U.S. residents are negative numbers. For example, when the U.S. companies export goods or services, they receive payments, which are recorded as positive entries in line 2 above. Similarly, when a U.S. resident receives dividends from a company he owns in a foreign country, those payments are recorded as positive entries in line 3 above. Conversely, when U.S. residents import goods and services from other countries, these payments are recorded as negative entries in line 5 and payments to foreigners who earn income from the U.S. are negative entries in line 6. Finally, **unilateral transfers** include foreign aid, grants, gifts, donations, etc.

The **financial account** records purchases of assets that a country has made abroad and foreign purchases of assets in the country. These assets include physical capital as well as financial assets, such as shares of stock and bonds. When investors in the U.S. buys foreign assets such as foreign government bonds, or when a U.S. firm builds a factory in another country, these payments are *capital outflow* from the U.S. and are recorded as negative entries in line 11. The *capital inflow* into the U.S. occurs when a foreign investor buys a bond issued by a U.S. company or government, or when a foreign firm builds a factory in the U.S. When firms build or buy facilities in foreign countries they engage in *foreign direct investment*, while purchases of financial assets are called *foreign portfolio investment*.

The **capital account** is the part of the balance of payments that records relatively minor transactions such as migrants transfers when they cross borders and also sales and purchases of assets that are neither produced nor financial assets, such as copyrights, patents, trademarks or right to natural resource.

The balance of payments is always balanced, up to statistical discrepancy. That is, the sum of the balance on current account and the financial and capital accounts must be zero. Notice that in 2005 the U.S. spent $791.5 more on goods and services and transfers than it received. This means that foreigners have accumulated $791.5 during 2005, which they either invested in the U.S. as purchases of assets or not spent at all. In the later case the non-spent amount is added to foreign holding of dollars, which is a positive entry in the financial account in line 12.

2 Exchange Rates

The balance of payments that we have seen in the previous section showed the summary of transactions between the U.S. and other countries in millions of dollars. However, when the U.S. residents are engaged in trade of goods, services and assets with other countries, these transactions involve other currencies. The price of one currency in term of another currency is called the **nominal exchange rate**. For example, the exchange rate between the dollar (\$) and the British pound (£) can be expressed as how many pounds are required to buy one dollar:

$$e\frac{\pounds}{\$} = 0.5\frac{\pounds}{\$}$$

The most confusing part about the exchange rates is that they can be expressed also in another way, for example how many dollars are needed in order to buy one pound:

$$e\frac{\$}{\pounds} = 2\frac{\$}{\pounds}$$

The notation £/\$ reads "pounds per dollar" and \$/£ reads "dollars per pound". The next table shows a few selected exchange rates expressed in both ways. The middle column shows the price of the U.S. dollar in units of other currencies and the third column shows the price of the foreign currencies in U.S. dollars.

American Dollar

click on values to see graphs	1 USD	in USD
Australian Dollar	1.27616	0.783601
Brazilian Real	2.1775	0.459242
British Pound	0.513031	1.9492
Canadian Dollar	1.1356	0.880592
Chinese Yuan	7.8303	0.127709
Danish Krone	5.6684	0.176417
Euro	0.760688	1.3146
Hong Kong Dollar	7.7751	0.128616
Indian Rupee	44.54	0.0224517
Japanese Yen	116.29	0.00859919
Malaysian Ringgit	3.625	0.275862
Mexican Peso	11.011	0.0908183
New Zealand Dollar	1.47189	0.679399
Norwegian Kroner	6.2675	0.159553
Singapore Dollar	1.5446	0.647417
South African Rand	7.14	0.140056
South Korean Won	930.4	0.00107481
Sri Lanka Rupee	108	0.00925926
Swedish Krona	6.9131	0.144653
Swiss Franc	1.2098	0.826583
Taiwan Dollar	32.49	0.0307787
Thai Baht	35.99	0.0277855
Venezuelan Bolivar	2144.6	0.000466287

using values from Wednesday, November 29, 2006

Example.

Q. Based on the above table, what is the exchange rate between the dollar and the euro?

A. We can say that the price of one U.S. dollar is 0.76 euro or the price of one euro is 1.31 dollars. Using our notation, the two ways of describing the exchange rate between the dollar and the euro are

$$e_{\frac{€}{\$}} = 0.76\frac{€}{\$}$$

or

$$e_{\frac{\$}{€}} = 1.31\frac{\$}{€}$$

In what follows, to avoid confusion, when we talk about exchange rate between the dollar and other currency, we will express it as the price of the dollar in units of that currency. For example, $e_{\frac{€}{\$}}$ is the exchange rate between euro and the dollar expressed in euros per dollar, and $e_{\frac{¥}{\$}}$ is the exchange rate between the yen and the dollar, expressed in yens per dollar.

2.1 Using the exchange rates

The exchange rates are useful for converting prices in one currency into another. Suppose the price of a television in the U.S. is \$200 and we want to convert this price into Japanese yen. Then,

$$P_{¥} = e\frac{¥}{\$}P_{\$} = 116 \cdot 200 = ¥23,200$$

Since each dollar is worth 116 yens, then 200 dollars are worth $116 \cdot 200$ yens. Now suppose that the price of a car in Japan is $2,088,000$ and we want to convert this price into dollars. Then,

$$P_{\$} = e\frac{\$}{¥}P_{¥} = \frac{P_{¥}}{e\frac{¥}{\$}} = \frac{2,088,000}{116} = \$18,000$$

Lets look at another example - the Big Mac. The price of the big mac in the U.S. is \$3.1 and the price in Japan is ¥250. Which one is cheaper? In order to compare these prices we need to convert them to common currency. So for example, lets convert the price in the U.S. into Japanese currency.

$$P_{¥} = e\frac{¥}{\$}P_{\$} = 116 \cdot 3.1 = ¥359.6$$

So the Japanese big mac is much cheaper than the U.S. big mac. Is this surprising? Did we expect the price of an identical good to be the same in all countries, when compared at a common currency? As we will show in the next section, the answer is "it depends"; it depends on whether the good is traded or not.

3 Law of One Price and Purchasing Power Parity (PPP)

The **law of one price** is the notion that the price of *traded goods* has to be the same in two countries when converted into a common currency. The reason why we expect the law of one price to hold is because if the price in one place is cheaper than in the other there is a possibility to perform an arbitrage: buying the good where it is cheaper and selling it where it is more expensive. In reality, the law of one price should hold when taking into account the transportation costs and tariffs. We do not expect the law of one price to hold for non-traded goods, such as haircuts and restaurant meals, the big mac included. We do expect the law of one price to hold for goods like crude oil, gold, and other traded goods.

A related concept is **Purchasing Power Parity** is a method of comparing the purchasing power of \$1 in different countries. The PPP between the U.S. and another country holds if \$1 has the same purchasing power in the other country. In other words, \$1 when converted to the other currency can buy the same goods in the foreign country as it can buy in the U.S. Suppose the price of a bundle of goods in the domestic economy (U.S.) is P and the price of the same bundle in the foreign country (in foreign currency) is P^*. Let the exchange rate between the dollar the foreign currency be $e\frac{c}{\$}$, where c is the name of the foreign currency. Then \$1 in the U.S. buys $1/P$ goods and \$1 when converted to the foreign currency can by e/P^* goods. If the PPP holds for *this bundle of goods* then we should have

$$\frac{1}{P} = e\frac{1}{P^*}$$

or

$$1 = e\frac{P}{P^*}$$

The right hand side of the last equation is called the **real exchange rate** (e^r), which shows the relative price of a bundle of domestic goods in terms of foreign goods.

$$e^r = e\frac{P}{P^*} \tag{1}$$

If PPP holds for this specific bundle, then $e^r = 1$. Of course we don't expect the PPP to hold for any bundle of goods, but we do expect it to hold for traded goods. For example, we have seen that PPP does not hold for the big mac.

We can check to what extent does the PPP hold for *all* the consumption goods as follows. Let the consumer price index in the U.S. be P, the the consumer price index in the foreign country be P^* and the exchange rate between the dollar the foreign currency be e. Then equation (1) can be used to compute the real exchange rate. If $e^r > 1$ then the domestic bundle is more expensive than the foreign bundle, and if $e^r < 1$ then the domestic bundle is cheaper than the foreign bundle.

If we though that there are forces that would drive the real exchange rate to 1 in the long run, then we could predict the future trend in the exchange rates. For example, if right now we have

$$e^r = e\frac{P}{P^*} > 1$$

and we believe that in the future the real exchange rate should be 1 ($e^r \to 1$) then we could predict that in the future the dollar should depreciate ($e \downarrow$) relative to the foreign currency. In the next section we will take a closer look at PPP.

3.1 Predicting future trends in exchange rates

A currency **appreciates** when its market value rises relative to another currency. A currency **depreciates** when its market value falls relative to another currency. It would be nice if we could predict the future trends of exchange rates. We realize that we should not expect the PPP to hold for all the consumption goods. But we do expect it to hold for traded goods. Let the price index in the U.S. be a weighted average of the price of traded goods P^T and non-traded goods P^N as follows

$$P = \alpha P^T + (1-\alpha) P^N, \quad \text{where } 0 \le \alpha \le 1$$

Similarly, let the price index in the foreign country be

$$P^* = \beta P^{*T} + (1-\beta) P^{*N}, \quad \text{where } 0 \le \beta \le 1$$

Then the real exchange rate is

$$e^r = e\frac{\alpha P^T + (1-\alpha) P^N}{\beta P^{*T} + (1-\beta) P^{*N}}$$

Rearranging the above

$$e^r = e\frac{P^T}{P^{*T}}\left[\frac{\alpha + (1-\alpha) P^N/P^T}{\beta + (1-\beta) P^{*N}/P^{*T}}\right] \tag{2}$$

The fractions P^N/P^T and P^{*N}/P^{*T} are ratios of prices of non-traded to traded goods in the home country and in the foreign country. If those ratios are more or less stable over time, then we expect the term in the brackets to be some constant C. Also, because of the law of one price we expect the PPP to hold for traded goods, that is

$$e\frac{P^T}{P^{*T}} = 1$$

Thus, the real exchange rate in equation (2) becomes constant

$$e^r = \underbrace{e\frac{P^T}{P^{*T}}}_{1}\underbrace{\left[\frac{\alpha + (1-\alpha)\,P^N/P^T}{\beta + (1-\beta)\,P^{*N}/P^{*T}}\right]}_{C} = C$$

With these assumptions we can predict the future movement in exchange rates using the definition of the real exchange rate in equation (1)

$$e^r = e\frac{P}{P^*} = C \tag{3}$$

Expressing the equation (3) in terms of rates of change gives the following approximation[1]

$$\hat{e} + \hat{P} - \hat{P}^* = \hat{C} \tag{4}$$

Since C is constant, we have $\hat{C} = 0$. Then equation (4) becomes

$$\hat{e} = \hat{P}^* - \hat{P} = \pi^* - \pi \tag{5}$$

where π is domestic inflation rate and π^* is foreign inflation rate. Equation (5) tells us something very intuitive. We expect the dollar to depreciate relative to the foreign currency if the domestic inflation is higher ($\pi\uparrow$) or if the foreign inflation is lower ($\pi^*\downarrow$). Higher domestic inflation means that the dollar is worth less while lower foreign inflation means that the foreign currency is worth relatively more.

To test equation (5) we can plot the expression $\hat{e} - (\pi^* - \pi)$ for some countries and see how close it is to zero. Figure 1 plots $\hat{e} - (\pi^* - \pi)$ for Canada, U.K. and Japan. Notice that although there are large fluctuations, the graphs tend to converge back to zero, which is consistent with the result in equation (5).

We can use the **quantity theory of money** to relate the movements in exchange rates to money growth and the growth in real output. Recall that the quantity equation is

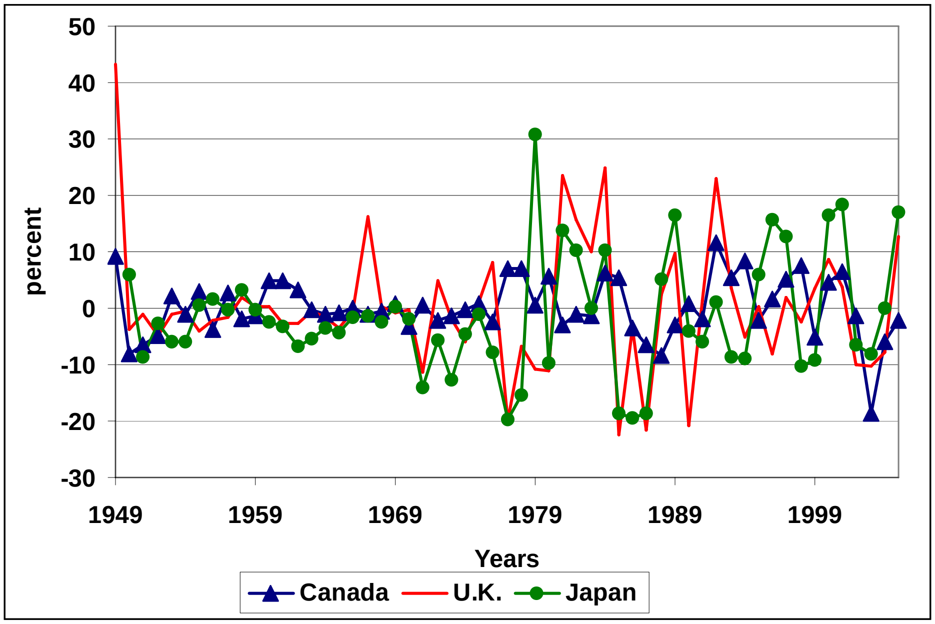
$$M = \frac{PY}{V}$$

where P is the price index, Y is the real GDP and V is the velocity of money. Expressed in growth rates, this is approximately

$$\begin{aligned} \hat{M} &= \hat{P} + \hat{Y} - \hat{V} \\ &\text{or} \\ \hat{P} &= \hat{M} - \hat{Y} + \hat{V} \end{aligned}$$

[1] Recall that a hat above the variable represents the rate of change in a variable. Formally, $\hat{x} = \frac{x_{t+1} - x_t}{x_t}$.

Figure 1: $\hat{e} - (\pi^* - \pi)$ for Canada, U.K. and Japan.



If we assume that in the short run the velocity is constant, then the above becomes $\hat{P} = \hat{M} - \hat{Y}$. Using this expression for inflation in equation (5) gives

$$\hat{e} = \underbrace{\hat{M}^* - \hat{Y}^*}_{\pi^*} - \underbrace{\left(\hat{M} - \hat{Y}\right)}_{\pi}$$

or

$$\hat{e} = \left(\hat{M}^* - \hat{M}\right) + \left(\hat{Y} - \hat{Y}^*\right) \quad (6)$$

From the last equation we see that if the domestic money supply grows faster than the foreign money supply, then the value of the dollar will tend to depreciate. On the other hand, if the real GDP in the domestic economy grows faster, the dollar will appreciate.

3.2 Fixed vs. floating exchange rate

Sometimes central banks in some countries decide to intervene in the market for foreign exchange in order to keep the exchange rate at some fixed level. There are two advantages to fixing the exchange rate. First, fixing the exchange rate reduces the uncertainty associated with exchange rate fluctuations. The second reason is that the fixed exchange rate helps to control inflation in the country. To understand how this is working recall equation (5) $\hat{e} = \pi^* - \pi$ which describes the relationship between the exchange rate and foreign and domestic inflation rates. If the nominal exchange rate is fixed, then $\hat{e} = 0$ and as a result the domestic inflation rate is equal to the foreign inflation rate: $\pi = \pi^*$. Sometimes fixing the nominal exchange rate for controlling inflation is referred to as using a **nominal anchor**, because it help to anchor (stop) the inflation rate.

Some people oppose to fixing the exchange rate because it neutralizes the discretionary monetary policy. From equation (6) we see that if the nominal exchange rate is fixed ($\hat{e} = 0$) then $\hat{M} = \hat{M}^* + \hat{Y} - \hat{Y}^*$, so the growth rate of domestic money is fixed by the the growth rate of the foreign currency and the growth of the real GDP in the home country and abroad. The concern is that shocks to the foreign money supply will be directly translated to the shocks of the domestic money supply. In other words, the domestic economy has no control over its money supply. This is why many economists advocate alternative ways to combat inflation, other than fixing the exchange rates. The capter about the Phillips curve and monetary policy commitment discusses in more length about the importance of commitment. Many economists propose solving the commitment problem of the central bank by adopting a monetary policy **rule**, i.e. specifying by law some inflation target or inflation interval.

4 Review Questions

1. Suppose that the price of a television in the U.S. is \$200 and the price of the same television in India is INR8,000 (INR stands for Indian Rupee). If televisions are traded goods and assuming that the law of one price holds, what should be the exchange rate between the dollar and the Indian rupee?

2. Suppose that the price index in the domestic economy is $P = \$100$ per basket of goods and the price of the same basket of goods in the foreign country is $P^* = c170$ (where c is the name of the foreign currency). The nominal exchange rate is $e = 2\frac{c}{\$}$.

   (a) Does the purchasing power parity hold between the two economies? Explain your answer.

   (b) If the answer to the previous question is "NO", then what should be the nominal exchange rate between the two countries for the PPP to hold?

3. Recall that equation (5) shows that under some assumptions the relationship between the growth in the nominal exchange rate and domestic and foreign inflation is given by $\hat{e} = \pi^* - \pi$.

   (a) Which assumptions were used to derive this result? Show your derivations.

   (b) How would you test if $\hat{e} = \pi^* - \pi$ holds in the data?

4. What are the consequesnces of fixing the nominal exchange rates on the effectiveness of domestic monetary policy?

5. Discuss the arguments in favor and against fixing the exchange rates.

Answers:

1. According to the law of one price, the price of a traded good should be the same in all countries when converted to a single currency. Thus

$$\begin{aligned} \$200 \cdot e\frac{INR}{\$} &= INR8,000 \\ e\frac{INR}{\$} &= \frac{8,000}{200} = 40\frac{INR}{\$} \end{aligned}$$

2. (a) To check if the PPP holds we need to compute the real exchange rate

$$e^r = e\frac{P}{P^*} = 2 \cdot \frac{100}{170} = \frac{200}{170} \neq 1$$

so the PPP does not hold since the real exchange rate is not equal to 1.

(b) In order for PPP to hold, the nominal exchange rate should be such that the real exchange rate is 1. Thus

$$\begin{aligned} e^r &= 1 = e \cdot \frac{100}{170} \\ &\Rightarrow e = 1.7\frac{c}{\$} \end{aligned}$$

3. (a) The the assumptions are: (1) the PPP holds for traded goods, (2) the ratios of the price of non-traded to traded goods are approximately constant in the two countries, and (3) the weights on traded and non-traded goods in each country (α, β) are fixed. Under these assumptions the real exchange rate is constant

$$e^r = \underbrace{e\frac{P^T}{P^{*T}}}_{1} \underbrace{\left[\frac{\alpha + (1-\alpha) P^N/P^T}{\beta + (1-\beta) P^{*N}/P^{*T}}\right]}_{C} = C$$

and expressed in terms of approximate growth rates

$$\begin{aligned} e^r &= e\frac{P}{P^*} = C \\ \hat{e} + \hat{P} - \hat{P}^* &= 0 \\ \hat{e} &= \pi^* - \pi \end{aligned}$$

(b) We can plot the time series of $\hat{e} - (\pi^* - \pi)$ and see if this time series is approximately 0. See the graph in figure (1).

4. See notes.

5. See notes.