1. The following Table lists some exchange rates. Answer all questions assuming no arbitrage costs.

<table>
<thead>
<tr>
<th>Currency</th>
<th>Exchange Rate (as US$ per foreign currency, except for Japan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swiss Franc</td>
<td>$0.759/Swiss Franc, $0.772/Swiss Franc</td>
</tr>
<tr>
<td>180-day forward</td>
<td></td>
</tr>
<tr>
<td>Euro</td>
<td>$1.175/Euro</td>
</tr>
<tr>
<td>British Pound</td>
<td>$1.715/£</td>
</tr>
<tr>
<td>Japanese Yen</td>
<td>118.7¥/$</td>
</tr>
<tr>
<td>180-day forward</td>
<td>116.08¥/$</td>
</tr>
</tbody>
</table>

a) The spot rate of the Yen in terms of the Euro is: 

\[
(118.7\text{¥}/\$) \times (1.175/\text{Euro}) = 139.47\text{¥}/\text{Euro}.
\]

b) The interest rate on the one year US Treasury bill is 4%. Since the Swiss franc is selling at a premium in the forward market (i.e., the forward price represents an appreciation against the dollar), we know Swiss interest rates are below US interest rates. Similarly, there is a forward premium on the Japanese yen (or the dollar is at a forward discount against the Yen), so Japanese interest rates are also lower than US interest rates.

The US 6 month interest rate is 2%. Using the covered interest arbitrage relation:

\[
R^{swiss} = R^{swiss} + \left(\frac{e^F - e^S}{e^S}\right) = R^{swiss} + \left(\frac{0.772 - 0.759}{0.759}\right) = R^{swiss} + 0.017 \rightarrow R^{swiss} = 0.02 - 0.017 = 0.003
\]

where \(e^F\) is the 6 month forward rate ($/SF) and \(e^S\) is the spot rate. Hence, \(R^{swiss} = 0.3\%

Since the Yen/$ rate is quoted in Yen per dollar, we could either take the reciprocal or write the covered interest arbitrage relations as:

\[
\frac{R^F}{R^S} = \frac{e^F - e^S}{E^S} = R^{swiss} + \left(\frac{116.08 - 118.7}{118.7}\right) = R^{swiss} - 0.022 \rightarrow R^F = 0.02 - 0.022 = -0.002
\]

where \(E\) is the (spot or forward) exchange rate in yen per dollar. Hence, according to the data, the Japanese 6 month interest rate is -0.2%. (In reality, the nominal interest rate can’t be negative, but US interest rates are slightly larger than in the problem. Japanese interest rates are, in fact, essentially zero).

c) Suppose your research department forecasts that, in 180 days, the spot price of the Swiss franc will be $0.80. Hence, you buy 1 million francs forward.

i. If you buy 1 million Swiss francs forward at the rate $0.772/SW, and if your forecast is correct, then your profits will be:

\[
\text{Cost of 1 million Swiss franc bought forward} = [1,000,000\text{SW} \times 0.772/\text{SW}] = 772,000
\]

\[
\text{Revenue of selling 1 million SF at spot rate $0.80/SF} = 800,000.
\]

\[
\text{Profits} = 28,000. \text{ Of course, for bigger profits, just buy more Swiss francs forward!}
\]
ii. If there are enough people speculating in the same way, the forward price of the Swiss franc should appreciate (towards $.80/SF). From covered interest arbitrage, the forward appreciation must either cause: (i) Swiss interest rates to fall, (ii) the US interest rate to rise, or (iii) the spot Swiss franc to appreciate.

2. Use covered interest arbitrage to explain the impact of the following on the spot $/Euro rate.

   a) A decrease in European interest rates, **given US interest rates and the forward rate**, will cause an appreciate of the spot dollar (a spot depreciation of the Euro against the $). Of course, if US interest rates also fall, then the spot rate need not change.

   b) If political uncertainty in Europe creates pessimism concerning the European economy and future exchange rates, then the forward rate of the Euro will depreciate (fewer $ will be required to buy a Euro in the forward market). Given interest rates, these expectations will then generate a spot depreciation of the Euro (of course, if European interest rates are increased, this could offset the forward depreciation of the Euro, so that spot rates do not change).

   c) A decrease in US interest rates, given the forward exchange rate and European interest rates, will cause a spot depreciation of the dollar against the Euro.

3. The “Monetary Theory of Exchange Rate Determination” is the principal theory used to understand how exogenous events are likely to affect exchange rates. In applying the theory, a distinction is made between the “short-run”, when goods prices are held fixed, and the “long run”, when goods prices are assumed to change. A distinction is also made between “temporary” and “permanent” changes in exogenous variables. Use this theory to explain how the following events are likely to affect the $/Euro exchange rate.

   a) **A temporary increase in the European money supply.** Since there is no permanent change in money supply (or anything else), there is no long run effect of this monetary expansion. Since prices are fixed in the short run, the temporary monetary expansion must cause: (i) a decline in European interest rates, but no change in the forward exchange rate. Hence, the spot Euro must depreciate against the dollar, while – by assumption – the price level does not change.

   b) **A permanent decrease in US real income.** First, since this is a one time change in income levels, there can be no permanent (long run) impact on the interest rate. Second, since prices will adjust in the long run, the decline in US real income reduces money demand and – given money supply and interest rates – must lead to an increase in the US price level. Third, because of purchasing power parity, the higher US price level must lead to a long run depreciation of the dollar. **Thus, the long run effects are: (i) US price level rises; (ii) dollar depreciates; but (iii) US interest rates are unchanged.**

   In the short run, the US price level is fixed; hence, to accommodate the reduced demand for money (due to lower US income levels), US short term interest rates must fall. This means the spot dollar must fall relative to the forward dollar. Hence, there is overshooting – the dollar depreciates more in the short run than in the long run.

   c) A decrease in the rate of monetary growth in the US from 7% to 4%. By money neutrality, assuming no change in real income growth, the decrease in the US money supply growth rate from 7% to 4% will lead to a 3% decrease in the inflation rate in the US. Assuming, for
simplicity, the $/Euro rate had been stable prior to this decrease in the US monetary growth rate, this implies the Euro will depreciate by 3% per year against the dollar to maintain purchasing power parity. Assuming the forward rate matches the future spot rate (because of rational expectations), covered interest arbitrage implies the U.S. nominal interest rate must decrease by 3%, given European interest rates (this also keeps U.S. real interest rates unchanged, and presumably equal to European real interest rates if p.p.p. holds). Finally, the decrease in nominal interest rates in the US – which occurs immediately, leads to an increase in money demand and thus an immediate appreciation of the dollar, followed by a continuing 3% per year appreciation rate of the dollar against the Euro. Since prices adjust immediately (in this model), and purchasing power parity holds, the immediate appreciation of the dollar leads to an immediate drop in the U.S. price level (even though the money supply is unchanged at the instant the new monetary policy is introduced). Thus, in summary, the decrease in the US monetary growth rate leads to an immediate appreciation of the dollar (even before the money supply has actually changed) and an immediate decrease in dollar prices and the US nominal interest rate, followed by a continuing appreciation of the dollar (to match the reduced money supply growth rate).

d) A revised forecast in December 2005 indicating lower European income levels for 2006 and thereafter than previously believed. From the exchange rate determination equation, we know that, ceteris paribus, lower European income levels will decrease the demand for Euros and thus cause the Euro to depreciate (dollar to appreciate) in 2006. Hence, if people believe this forecast for 2006, they will expect the $ to appreciate in 2006 - meaning the current forward rate of the $ will appreciate. Through covered interest arbitrage, this will make US securities look more attractive (compared to foreign securities), meaning European interest rates must rise, U.S. interest rates fall or the spot rate of the Euro depreciates. In this case, since neither income nor money supply has changed immediately, and since prices do not change in the short run, interest rates must also be unchanged. This means that the spot Euro must depreciate ($ appreciate).

4. Using the aggregate demand-aggregate supply model of Chapter 16:

a) Show how a permanent increase in the money supply affects the exchange rate and income levels in the short run and in the long run.

The key here is identifying what variables can change, and what are fixed, in each “time period”. By assumption, in the short run prices are fixed, but real income levels can change; in the long run, prices may adjust, but real income will equal its full employment level (and thus is not affected by policy).

Working backward, in the long run prices and the exchange rate will “increase” (depreciate) in proportion to the money supply increase, but income levels and interest rates will not change.

Thus, for the long run: \[ \frac{\Delta P}{P} = \frac{\Delta E}{E} = \frac{\Delta M}{M} \]

In the short run, prices are fixed; thus, interest rates must change (decrease) to absorb the additional money supply. In addition, the forward exchange rate depreciates; thus, the spot exchange rate must depreciate, and by more than in the long run (because of the temporary decrease in the interest rate due to the price rigidity). The lower interest rate (in the short run) and depreciation of the currency (implying a short run depreciation of the real exchange rate)
increases the demand for domestic goods, implying that the money supply increase temporarily increases income.

In the figure above, $K$ represents the original equilibrium, and $Y^*$ represents the equilibrium (full employment) level of income. Given prices, the money expansion shifts the money market curve (AA) out to (A’A’), reflecting the short run depreciation of the currency. Given prices, this depreciation makes domestic goods relatively cheaper, and leads to higher income in the short run. The point $L$ marks the short run impact of the monetary expansion.

Over time, prices of goods increase; this shifts the $A’A’$ curve downward, to $A^*A^*$ (since higher prices reduce real money balances) and shifts the aggregate demand curve $DD$ upward to $D^*D^*$ as, given the exchange rate, higher prices reduce demand for domestic goods (through the current account). Thus, in adjusting to the long run equilibrium, the exchange rate appreciates and income declines (relative to the short run effect); the long run equilibrium is at $M$. The dotted line from $L$ to $M$ shows this adjustment, and reflects the “overshooting” phenomenon discussed in Chapter 14.

b) Show how a temporary increase in government spending affects the exchange rate and income level in the short run. What is the short run effect of a permanent increase in government spending? Why?

Again, the distinction between short run and long run depends on whether prices (or income) are held fixed, whereas the distinction between temporary and permanent depends on whether the forward exchange rate changes (which is crucial in determining how the spot exchange rate and interest rates change).

With a temporary increase in government spending, the forward exchange rate does not change. The increased fiscal spending increases aggregate demand and hence leads to an appreciation of the real exchange rate; since prices are fixed, this must come about due to a spot appreciation of the nominal exchange rate ($E$). In the money market, the spot appreciation,
coupled with an unchanged future exchange rate, means domestic interest rates rise (as they must so that money demand accommodates the increased income levels). This is all shown in the diagram below; the \( AA \) curve **does not shift** (since prices, money supply and the forward exchange rate are all fixed), while the DD curve shifts down due to the fiscal expansion; the equilibrium temporarily moves from \( L \) to \( M \). The temporary policy leads to a (temporary) increase in income and appreciation of the exchange rate.

Finally, a **permanent** increase in fiscal policy will cause a permanent increase in the real exchange rate. In the long run, real income will be unchanged (by the assumption of full employment) and the nominal interest rate will be unchanged (since, in the long run, spot and forward exchange rates will be equal). But, from money market equilibrium, this implies that the long run domestic price level **will not change** from its current level (otherwise real money balances would change, which would be inconsistent with money market equilibrium). **Thus, the long run impact** of the permanent fiscal expansion is to lead to an appreciation of the nominal (and real) exchange rate, but no change in the price level or in income levels. But since price levels do not change, the short run and long run impacts are identical! **Permanent fiscal policy has no impact on equilibrium income, even in the short run.**

This result can be represented in a diagram like that above; the only difference is, since the forward rate appreciates, the \( AA \) curve shifts down (to \( A'A' \)). And since the short run and long run are the same, the new equilibrium income must be the same as the old equilibrium. Hence, in the diagram, the equilibrium jumps immediately from \( L \) to \( N \).