1. The following Table lists some (current) exchange rates. Answer all questions as if there were 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>Canada (dollar)</td>
<td>$.69/Can$</td>
</tr>
<tr>
<td>Euro</td>
<td>$1.09/Euro</td>
</tr>
<tr>
<td>180-day forward rate</td>
<td>1.08/Euro</td>
</tr>
<tr>
<td>British Pound</td>
<td>$1.57/£</td>
</tr>
<tr>
<td>Japanese Yen</td>
<td>119.69¥/$</td>
</tr>
<tr>
<td>180-day forward rate</td>
<td>118.91¥/$</td>
</tr>
</tbody>
</table>

a) The spot rate of the Yen in terms of the British pound can be determined as follows: determine how many yen per US dollar, how many US $ per British pound and multiply: from the table: \((119.69 \text{¥/$}) \times (1.57/£) = 187.91 \text{¥/£}\)

b) The semi-annual US interest rate is 1.5%; since the forward rate of the Euro is below the spot rates, you will require a higher interest rate on Euro assets to be willing to hold them.

From the formula in class:

\[
R^{us} = R^{uk} + \left( \left( \frac{E^f - E^s}{E^s} \right) \right) .015 = R^{uk} + (-.01/1.09) = R^{uk} - .0092 \rightarrow
\]

\[
R^{uk} = .015 + .0092 = .0242 \text{ or } R^{uk} = 2.42\% \text{ (semi-annual interest rate).}
\]

The forward rate on the yen is above the spot rate (i.e., the yen increases in value) so Japanese interest rates should be lower than US rates. Thus:

\[
\left( \frac{E^f_{\text{JPY}} - E^s_{\text{JPY}}}{E^s_{\text{JPY}}} \right) \cdot 100 \geq 0.66 , \text{ so: } R^f = 1.50 - .66 = 0.84\%.
\]

c) Suppose your research department forecasts that, in 180 days, the spot price of the Euro will $1.03. On the basis of this information, you buy 1 million Euro forward.

i. If your research department is correct, you will make $.05 per Euro, or $50,000 from this speculative purchase.

ii. If enough people have the same beliefs (or your forward sales of the euro are large enough), this will cause the forward rate of the Euro to depreciate. As a result of this depreciation in the forward rate, through covered interest arbitrage people will wish to sell Euros spot, or will reduce investment in Euro interest bearing assets (increase holdings of $ interest-bearing assets). Consequently, one of the following must happen: US interest rates decrease, British interest rates increase, and/or the spot Euro depreciates. Further, movements in either interest rate (as indicated) will cause the spot Euro to depreciate (unless the European Central Bank (ECB) decreases the money supply). Hence, speculation (beliefs) on forward rates will affect spot rates.
2. Use the covered interest arbitrage relationship to explain how the following are likely to affect the spot $/Euro rate. In answering, explain your reasoning (and, in particular, what variables you are holding fixed):

a) An increase in Euro interest rates: to know exactly what happens, you need to know why Euro interest rates increased. However, through the covered interest arbitrage relationship, we must have: US interest rates increase, the forward Euro depreciates or the spot Euro appreciates. Thus, if we take as given the forward exchange rate and US interest rates, the spot rate of the Euro will appreciate. (It is key in all of these to specify what is fixed; not part of the question, but behind the scenes, is the issue of why, for example, Euro interest rates increased. A consistent explanation here would be a temporary decrease in the Euro money supply or a change in expectations that led to a depreciation in the forward Euro).

b) A change in the forward rate affects the covered interest arbitrage relationship. Thus, if people expect a (future) appreciation of the dollar against the Euro, that will lead to an appreciation of the dollar (depreciation of the Euro) in the forward market, thereby leading to either a spot depreciation of the Euro and/or higher Euro interest rates (or lower US interest rates).

c) A decrease in US interest rates will work much like part (a): Euro interest rates must decrease, or else US assets look less attractive (in the short run). So, if Euro interest rates do not decrease, people will sell $ for Euros, causing a spot appreciation of the Euro (and, with covering, potentially a forward Euro depreciation). But to know what happens we need to know what precipitated the decline in US interest rates; a consistent explanation would be a temporary increase in the US money supply.

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. Use the theory to explain how the following events are likely to effect the $/Euro exchange rate.

a) A temporary decrease in the U.S. money supply. Since the decrease is assumed temporary, it will have no long run effects, and thus no impact on the forward rate. Thus, given goods prices in the short run, US interests rates have to rise to clear the money market. The increase in US interest rates makes US securities more attractive, and thus causes a spot appreciation of the dollar. By assumption, there are no long run effects.

b) A permanent one-time increase in the Euro money supply. Due to money neutrality, we know this will - in the long run - cause Euro prices to increase proportionately. Assuming purchasing power parity, we would thus expect a long run depreciation of the Euro equal to the proportionate increase in the money supply (hence, the forward rate depreciates). Since prices are sticky in the short run, this means Euro interest rates must fall (temporarily) to accommodate the increased (real) money supply. The lower Euro interest rates, plus the forward depreciation of the Euro, both imply a spot depreciation of the Euro. However, since in the long run, Euro interest rates must return to their original level (the long run real interest rate is unaffected), this
means that the spot exchange rate must depreciate by more than the forward rate - representing the overshooting of the exchange rate. Hence:

Long Run: \( (\Delta e/e) = (\Delta P/P) = (\Delta M/M), \quad \Delta r = 0 \)

Short run: \( (\Delta e/e) > (\Delta M/M), \quad \Delta P = 0, \quad \Delta r < 0 \)

c) An increase in the rate of monetary growth in the US from 3% to 6%. Again, by money neutrality, assuming no change in real income growth, the increase in the US money supply growth rate from 3% to 6% will lead to a 3% increase in the inflation rate in the US. Assuming, for simplicity, the Euro/$ rate had been stable prior to this increase in the US monetary growth rate, this implies the Euro will appreciate by 3% per year against the dollar to maintain purchasing power parity. To maintain real interest rates in the US (equal to Euro rates), this implies the nominal interest rate in the US will increase by 3% points. Finally, the increase in nominal interest rates in the US will lead to an immediate depreciation of the dollar (as people wish to hold fewer dollars because of higher interest rates), followed by a continuing 3% per year depreciation rate. Thus, in summary, the increase in the monetary growth rate leads to an immediate depreciation of the dollar (even before the money supply has actually changed) and an immediate increase in dollar prices and the US nominal interest rate, followed by a continuing depreciation of the dollar (to match the money supply growth rate). The results come from the following formulas:

\[
M^{eu} = P^{eu} \cdot L^{eu} \left( Y^{eu}, r^{eu} \right); \quad M^{us} = P^{us} \cdot L^{us} \left( Y^{us}, r^{us} \right);
\]

\[
r^{us} = r^{eu} + \left( e^{f} - e^{s} \right) / e^{s} \]

where: \( e^{f} \) is the forward rate (\$/Euro) and \( e^{s} \) is the spot rate. Using purchasing power parity: \( P^{us} = e_{s/Euro} \cdot P^{eu} \) we have:

\[
\frac{M^{us}}{M^{eu}} = \left( \frac{P^{us}}{P^{eu}} \right) \left( \frac{L^{us} \left( Y^{us}, r^{us} \right)}{L^{eu} \left( Y^{eu}, r^{eu} \right)} \right) = e_{s/Euro} \cdot \left( \frac{L^{us} \left( Y^{us}, r^{us} \right)}{L^{eu} \left( Y^{eu}, r^{eu} \right)} \right)
\]

Thus, if the US money supply growth rate increases by 3%, the (continual) depreciation of the dollar will have to increase by 3% (i.e., in a steady state equilibrium, with no real income growth: \( \left( \Delta e/e \right) = \left( \Delta M^{us}/M^{us} \right) - \left( \Delta M^{eu}/M^{eu} \right) \).

By covered interest arbitrage, that means the 3% increase in US monetary growth rates (causing the change in forward rates) increases US long-term nominal rates by 3%. Finally by the exchange rate determination equation, the higher nominal US interest rates (due to the increased monetary growth rate in the US) lead to an immediate depreciation of the dollar (even though money supplies have not yet changed) and hence an immediate jump in US prices (in dollars).

d) A revised forecast in April 2003 indicating lower U.S. income levels for 2004 than previously believed. From the exchange rate determination equation given in part (c), we know that, ceteris paribus, lower U.S. income levels will decrease the demand for dollars and thus cause the dollar to depreciate in 2004. Hence, if people believe this forecast for 2004, they will expect the $ to depreciate in 2004 - meaning the current forward rate of the $ will depreciate. Through covered interest arbitrage,
this will make US securities look less attractive (compared to foreign securities), meaning U.S. interest rates will rise or the spot rate of the $ will depreciate (both will happen: the increase in US interest rates causes the spot depreciation). Thus, in this case higher U.S. interest rates are associated with a weaker (depreciating) dollar. On the other hand, for example, a temporary decrease in the U.S. money supply will cause higher interest rates and a (temporary) appreciation of the dollar. Thus, you cannot say that higher interest rates lead to an appreciation (or depreciation) of the dollar because interest rates, like exchange rates, are endogenous - determined by supply and demand. You have to explain why interest rates change in order to predict how the exchange rate will change (note the difference in the two examples cited).

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) means 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 \( A^*A^* \) (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. 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 rate and interest rates change).

**With a temporary increase**, the forward exchange rate does not change. The increased fiscal spending increases 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 to accommodate 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 $N$. 

\[ E \]