Practice questions: Set #6

What should you do with this set?

To help students prepare for the exam and the case, seven problem sets with solutions shall be handed out. They shall not be graded: the number of “points” for a question merely indicates the amount of time that I expect well-prepared students to spend answering that question.

Students are strongly encouraged to try hard to solve them and to use office hours to discuss any problems they may have doing so. The best self-test for a student of his or her command of the material before the final exam is whether he or she can handle the questions of the relevant homework’s. To reflect this close association between practice sets and exams, the final exam shall include at least a part of a question from the relevant practice sets.

Question 1. (10 points)

Starting in early 1989, Japanese interest rates were about 4% lower than U.S. rates for similar maturities. This wide difference prompted quite a few US real-estate companies at the time to borrow in ¥ to finance US developments. In a similar vein, many Japanese retail investors today engage in carry trades – borrowing in Yen at very low interest rates and investing in other currencies (mainly the Australian dollar and the Brazilian real) at higher interest rates. Likewise, many Hungarian corporations in 2005-2007 financed their domestic operations by borrowing in Swiss Francs at low interest rates. Comment on these related strategies.

(Hint 1: what might account for the difference between interest rates in different countries?)
(Hint 2: what risk do these developers/investors expose themselves to?)

Question 2. (10 points)

Assume that the 6-month interest rate in Australia is currently about 5.25% and expected inflation is about 2.5%. Meanwhile, the equivalent interest rate in Japan is 0.5%, and inflation is about -0.5% (deflation). All rates are annualized.

a. What should be the annualized forward discount or premium at which the A$ will sell against the Yen? What assumptions did you use to answer the question? Explain, intuitively and formally.

(Hint: do you need all the information provided?)

b. Suppose that the annualized expected inflation rate in Britain is 5.5%. What is your estimate of the annualized 6-month forward discount or premium at which the pound sterling should be selling against the Australian dollar? What assumptions did you use to answer the question? Explain, intuitively and formally.
Question 3. (10 points – International Pricing)

We are in 2000. IBM is asked by a Belgian company to quote a price in BF (Belgian Francs) for computer equipment. The computers will be paid in 4 equal quarterly BEF installments, beginning 90 days from now. IBM wants a minimum current $ price of $2.5 m to accept the contract. If the spot and forward rates for the BEF are as follows:

<table>
<thead>
<tr>
<th>spot</th>
<th>90 days</th>
<th>180 days</th>
<th>270 days</th>
<th>360 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.0307</td>
<td>$0.0302</td>
<td>$0.0298</td>
<td>$0.0293</td>
<td>$0.0287</td>
</tr>
</tbody>
</table>

then what is the minimum BF price that IBM should quote for this order? The relevant annualized interest rates in the US are:

<table>
<thead>
<tr>
<th>maturity (# months)</th>
<th>rate(%)</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
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<tr>
<td>6</td>
<td>4.5</td>
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<td>9</td>
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<tr>
<td>12</td>
<td>5.5</td>
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</tbody>
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Explain.

Question 4. (15 points)

We are in 1998. Suppose that, with no inflation, the cash-flow of a new project in Spain is expected to be Ptas 200m 2 years from now. Now suppose that Spanish inflation is forecast to be 8% annually, but that the project's cash flows will grow at only 5% in that period (because depreciation write-offs will remain constant). The current exchange rate is Pta 1 = $0.01. If U.S. inflation in the same period is expected to be 4% per annum and PPP holds, what is the forecast $ cash-flow in year 2? Explain.
Practice set #6 & Solution

Question 1. (10 points)

Starting in early 1989, Japanese interest rates were about 4% lower than U.S. rates for similar maturities. This wide difference prompted quite a few US real-estate companies at the time to borrow in ¥ to finance US developments. In a similar vein, many Japanese retail investors today engage in carry trades – borrowing in Yen at very low interest rates and investing in other currencies (mainly the Australian dollar and the Brazilian real) at higher interest rates. Likewise, many Hungarian corporations in 2005-2007 financed their domestic operations by borrowing in Swiss Francs at low interest rates. Comment on these related strategies.

(Hint 1: what might account for the difference between interest rates in different countries?)
(Hint 2: what risk do these developers/investors expose themselves to?)

Answer

In order to judge the soundness of that strategy, we would need to know what accounts for the 4% difference in nominal interest rates.

If PPP holds -- or, put differently, if real rates are the same across countries -- then the difference in nominal rates between the US and Japan is only due to inflation differentials. In this case, it is likely that all the gain the developers will make on the interest payments will be eaten up by an appreciation of the ¥ against the $ (remember, the ¥ loan must be repaid in ¥, and similarly the interest payments will be in ¥).

We have just argued that the expected cost of the two loans should be about the same when measured in the same currency. Notice also that, by borrowing in foreign currency, the U.S. developers are exposing themselves to fluctuations in the exchange rate, over and above what is predicted by inflation differentials.

Question 2. (10 points)

Assume that the 6-month interest rate in Australia is currently about 5.25% and expected inflation is about 2.5%. Meanwhile, the equivalent interest rate in Japan is 0.5%, and inflation is about -0.5% (deflation). All rates are annualized.

a. What should be the annualized forward discount or premium at which the A$ will sell against the Yen? What assumptions did you use to answer the question? Explain, intuitively and formally.

(Hint: do you need all the information provided?)

Answer

No need for assumptions in part a of this question. From covered interest rate parity, we know that the Australian $ should sell at a discount against the ¥ roughly equal to the interest rate
differential between Australia and Japan, i.e., the A$ should trade at a forward discount in order to offset the higher interest rate in Australia.

Formally, let s and f denote the spot and 6-month forward rates (#A$/1¥), respectively. Then the forward premium at which the ¥ will trade should be equal to:

$$\frac{f_{t,T} - s_t}{s_t} = \frac{(i - i^*) \frac{T}{360}}{1 + i^* \frac{T}{360}} = \frac{(5.25\% - 0.5\%) \frac{180}{360}}{1 + 0.5\% \frac{180}{360}} = 2.37\%$$

The formula can be rewritten to yield the forward discount at which the A$ should be trading against the ¥:

$$\frac{1}{f_{t,T}} - \frac{1}{s_t} = \frac{(i^* - i) \frac{T}{360}}{1 + i^* \frac{T}{360}} = \frac{(0.5\% - 5.25\%) \frac{180}{360}}{1 + 5.25\% \frac{180}{360}} = -2.31\%$$

That is, the Australian dollar should be at a 2.31% 6-month forward discount against the ¥. On an annualized basis, we should have the dollar trading at a 4.62% 6-month forward discount.

b. Suppose that the annualized expected inflation rate in Britain is 5.5%. What is your estimate of the annualized 6-month forward discount or premium at which the pound should be selling against the A$? What assumptions did you use to answer the question? Explain, intuitively and formally.

**Answer**

Discussing forward discounts or premia requires that we have nominal interest rate data. That piece of data is lacking in the question. Notice, however, that the real interest rate in Australia is equal to 5.25%-2.5%=2.75%. If real interest rates are equal across countries, then the real rate in Britain should be 2.75% too. To "guesstimate" the nominal rate in Britain, we can just add this estimate of the real interest rate -- 2.75% -- to the expected inflation rate -- 5.5% and obtain a nominal interest rate in Britain of about 8.25%.

Intuitively, since the nominal interest rate in Australia is 5.25%, we find that the A$ should sell at a premium against the pound roughly equal to the interest rate differential between Australia and Britain, i.e., the A$ should trade at a forward premium of 8.25%-5.25% = 3% in order to offset the higher interest rate in Britain.

Formally, if real rates are identical then the pound will be selling at an annualized 6-month forward discount of:

$$\frac{f_{t,T} - s_t}{s_t} = \frac{(i_S - i^*_{SKr}) \frac{T}{360}}{1 + i^*_{SKr} \frac{T}{360}} = \frac{(5.25\% - 8.25\%) \frac{180}{360}}{1 + 8.25\% \frac{180}{360}} = -2.88\%$$ against the $. 

Note: for some reason, the equation editor makes the Skr symbol appear in the formula instead of the £. Needless to say, the Swedish Krone has nothing to do with the example at hand.
**Question 3. (10 points)**

We are in 2000. IBM is asked by a Belgian company to quote a price in Belgian Francs (the Euro was not yet legal tender) for computer equipment. The computers will be paid in 4 equal quarterly BEF installments, beginning 90 days from now. IBM wants a minimum current $ price of $2.5 m to accept the contract. The spot and forward rates for the BEF are as follows:

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</tr>
</tbody>
</table>

What is the minimum BEF price that IBM should quote for this order? The relevant (risk-adjusted) annualized discount rates in the US are:

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<thead>
<tr>
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<td>3</td>
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Explain.

**Answer.**

The question boils down to finding the quarterly payment in Belgian Francs (say Y) that, when converted into US dollars at the expected (or forward) exchange rates relevant to cash-flows in 3, 6, 9 and 12 months and present-valued at the relevant discount rates, yields $2.5m.

Formally, IBM's problem can be written as finding Y such that:

\[
\text{\$ 2.5m} = \frac{0.0302 \times Y}{(1+0.04)^{\frac{90}{360}}} + \frac{0.0298 \times Y}{(1+0.045)^{\frac{180}{360}}} + \frac{0.0293 \times Y}{(1+0.05)^{\frac{270}{360}}} + \frac{0.0287 \times Y}{(1+0.055)^{\frac{360}{360}}}
\]

To obtain the above formula, we have used two facts. The first fact is that the use of forward rates is necessary to lock in the $ value of future BF cash-flows. The second is that cash-flows, hedged or not, need to be properly discounted when they take place in the future.

The value of Y that solves this equation is Y = BF 21,835,968. The price that IBM should quote is thus 4 (four) times that quarterly amount or BF 87,343,873.

**Question 4. (15 points)**

We are in 1998. Suppose that, with no inflation, the cash-flow of a new project in Spain is expected to be Ptas 200m 2 years from now. Now suppose that Spanish inflation is forecast to be 8% annually, but that the project's cash flows will grow at only 5% in that period (because depreciation write-offs will remain constant). The current exchange rate is Pta 1 = $0.01. If U.S. inflation in the same period is expected to be 4% per annum and PPP holds, what is the forecast $ cash-flow in year 2? Explain.
Answer.

What we are looking for is a projected dollar cash-flow in 2 years. To get that number, we need the projected Ptas cash-flow in year 2, and the projected FX rate at that time.

To get the first figure, simply notice that the project cash-flow in Ptas will grow at 5% per year, and hence 2 years from now will be equal to Ptas 200m \((1.05)^2\) = Ptas 220.5.

To convert Ptas 220.5 into US dollars, we need to forecast the exchange rate in 2 years. Intuitively, if PPP holds and if inflation is higher in Spain than in the US by about 4% per year, then the $ should appreciate against the Pta by about 4% per year. Formally, the USD/PTA exchange rate (in American terms) will change according to the inflation differential:

\[
\begin{align*}
\text{year 0 (now): } & \quad \text{1Pta} = \$0.01 \\
\text{year 1: } & \quad \text{1Pta} = \$0.01 \times \frac{1.04}{1.08} = \$0.00963 \\
\text{year 2: } & \quad \text{1Pta} = \$0.00963 \times \frac{1.04}{1.08} = \$0.00927
\end{align*}
\]

The year 2 nominal $ cash-flow is thus given by: Ptas 220.5 \times 0.00927 (\$/Pta) = \$2.045m.