Chapter 21
Interest Rate and Foreign Currency Swaps

PROBLEMS

2. Pfizer is a U.S. firm with considerable euro assets. It is considering entering into a currency swap involving $10 million of its dollar debt for an equivalent amount of euro debt. Suppose the maturity of the swap is 8 years, and the interest rate on Pfizer’s outstanding 8-year dollar debt is 11%. The interest rate on the euro debt is 9%. The current spot exchange rate is $1.35/€. How could a swap be structured?

Answer: Pfizer wants to swap out of $10 million of dollar debt that has an 11% interest rate and to swap into an equivalent amount of euro-denominated debt that will require payments of 9% per annum. At the spot exchange rate of $1.35/€, the $10 million is equivalent to

\[
\frac{10,000,000}{1.35/€} = 7,407,407.41
\]

Thus, at the beginning of the swap, Pfizer would transfer $10,000,000 to the financial intermediary, and Pfizer would receive €7,407,407.41. If interest is paid semi-annually, Pfizer would receive

\[
0.5 \times 0.11 \times 10,000,000 = 550,000
\]

every 6 months for 8 years. Pfizer would have to pay

\[
0.5 \times 0.09 \times 7,407,407.41 = 333,333.33
\]

After 8 years, the original principals would also be exchanged. Pfizer would receive $10,000,000 from the financial intermediary, and Pfizer would pay €7,407,407.41 to the financial intermediary.

4. The swap desk at UBS is quoting the following rates on 5-year swaps versus 6 month dollar LIBOR:

- U.S. dollars: 8.75% bid and 8.85% offered
- Swiss francs: 5.25% bid and 5.35% offered

You would like to swap out of Swiss franc debt with a principal of CHF25,000,000 and into fixed-rate dollar debt. At what rates will UBS handle the transaction? If the current exchange rate is CHF1.3/$, what would the cash flows be?

Answer: Because you want to swap out of Swiss franc debt, you want UBS to pay you Swiss francs and you want to pay UBS dollars. UBS pays Swiss francs at 5.25%, and it receives dollars at 8.85%. When you receive Swiss francs, you pay 6-month dollar LIBOR on the equivalent dollar amount, and when you pay dollars, you receive 6-month dollar LIBOR on that same dollar amount. Thus, the floating rate dollar cash flows cancel, and you would just make the fixed rate dollar payment and would receive the fixed rate Swiss franc payment.

In the beginning of the currency swap, you would give the Swiss franc principal of...
CHF25,000,000 to UBS who would give you
\[
\frac{\text{CHF25,000,000}}{\text{CHF1.3/\$}} = \$19,230,769
\]
You would then make semi-annual dollar payments of
\[
0.5 \times 8.85\% \times \$19,230,769 = \$850,962
\]
You would receive semi-annual Swiss franc payments of
\[
0.5 \times 5.25\% \times \text{CHF25,000,000} = \text{CHF656,250}
\]
At the end of 5 years, you would also pay the principal of $19,230,769 and you would receive the CHF25,000,000.

7. Suppose Sony issues $100,000,000 of 5-year dollar bonds. Nomura will handle the bond issue for a fee of 1.875%. Sony’s bonds will be priced at par if they carry a coupon of 8.5%. As the swap trader for Mitsubishi UFJ (MUFG), you have been quoting the following rates on 5-year swaps:

U.S. dollars: 8.00% bid and 8.10% offered against the 6-month dollar LIBOR
Japanese yen: 4.50% bid and 4.60% offered against the 6-month dollar LIBOR

Sony would like to do the dollar bond issue, but it prefers to have fixed-rate yen debt. If MUFG gets the proceeds of the dollar bond issue, giving Sony an equivalent amount of yen, and MUFG agrees to make the dollar interest payments associated with Sony’s dollar bonds, what yen interest payments should MUFG charge Sony? What is Sony’s all-in cost in yen? The current spot exchange rate is ¥98.50/$.  

Answer: The following exhibit provides the analysis, which is explained below.
Sony’s Dollar Bond Issue and Cash Flows in the Swap into Yen with MUFJ
(All cash flows are in millions of dollars or yen)

<table>
<thead>
<tr>
<th>Year</th>
<th>notional $</th>
<th>notional ¥</th>
<th>extra dollar interest</th>
<th>extra yen interest</th>
<th>Effective cash flows</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>98.13</td>
<td>-98.13</td>
<td>0.25</td>
<td>22.59</td>
<td>-249.14</td>
</tr>
<tr>
<td>0.5</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>1</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>1.5</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>2</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>2.5</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>3</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>3.5</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>4</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>4.5</td>
<td>-4.25</td>
<td>4.00</td>
<td>-226.55</td>
<td>0.25</td>
<td>-249.14</td>
</tr>
<tr>
<td>5</td>
<td>-104.25</td>
<td>104.25</td>
<td>-10,076.55</td>
<td>0.25</td>
<td>-10,099.14</td>
</tr>
<tr>
<td>AIC</td>
<td>4.49%</td>
<td>4.49%</td>
<td>2.30%</td>
<td></td>
<td>2.75%</td>
</tr>
<tr>
<td>Annual AIC</td>
<td>9.17%</td>
<td>8.16%</td>
<td>9.17%</td>
<td>4.65%</td>
<td>5.57%</td>
</tr>
</tbody>
</table>

Note: The present value at 4.00% of the 10 extra interest payment of $0.25 million is $2.03 million. This is equivalent to 199.73 million yen at the current exchange rate. The present value at 2.30% of 10 extra interest payment of 22.59 million yen is 199.73 million yen. The annual AIC calculations compound the semi-annual rates, e.g. (1.0449^2) = 1.0917.

The first thing to determine is the dollar proceeds of the bond issue. Because it is priced at par, Sony will receive 1.875% less than the $100 million provided by investors:

\[ $100,000,000 \times (1 - 0.01875) = $98,125,000 \]

This amount will be given to MUFJ in exchange for an equal amount of yen:

\[ $98,125,000 \times ¥98.50/\$ = ¥9,665,312,500 \]

To determine the interest payments, we must examine what MUFJ is quoting. When MUFJ does a 5-year swap and pays $100 million of principal, it expects to pay interest at 8% or 4% semi-annually. Sony wants it to pay the interest on its outstanding bond, which has a semi-annual coupon of 8.5%. Thus, there is an extra $0.25 million of interest every half year for 5 years. This amount is given in the column labeled extra dollar interest.

The yen principal that is associated with $100 million at the current exchange rate of ¥98.50/\$ is

\[ $100,000,000 \times ¥98.50/\$ = ¥9,850,000,000 \]

MUFJ would normally receive interest on this amount at 4.6% from Sony, which would be ¥226.55 million every half year, but we must increase the yen interest to reflect the increase in dollar interest that MUFJ is paying. In the absence of spot interest rates for each maturity, we can take the present value of the extra dollar interest at 8%. This amount is $2.03 million. The yen value of this dollar amount at the current exchange rate is ¥199.03 million. The sequence of 10 semi-annual payments that is equivalent to ¥199.03 million is ¥22.59 million. We must add this interest to the ¥226.55 million to get the full interest that Sony will pay. Thus, Sony receives ¥9,665,312,500 in the beginning of the swap, pays semi-annual interest of ¥249.14 million for 5 years, and pays the principal amount of ¥9,850,000,000 in year 5. The all-in-cost of this yen loan is 5.57%. Notice that 5.57% is only 92 basis points above the all-in cost of the quoted yen interest rate in the swap, whereas the original dollar bond is 101 basis points above the all-in cost of the quoted dollar interest rate. Increasing the cost of the yen loan by 101 basis points would have over-charged Sony because a yen basis point in the future is worth more than a dollar basis point in the future because the yen is...
strengthening relative to the dollar.

8. Assume that 1 year has passed since you entered into the transaction described in problem 4. Assume that the new spot exchange rate is CHF1.45/$ and that UBS is now quoting the following interest rates on 4-year swaps:

- U.S. dollars: 7.50% bid and 7.60% offered against the 6-month dollar LIBOR
- Swiss francs: 6.75% bid and 6.85% offered against the 6-month dollar LIBOR

If you close out the swap transaction of problem 4, what net dollar cash flow will you experience? Explain why this is the correct amount. You can assume that the term structures of interest rates in both currencies are flat.

Answer: You owe eight additional semi-annual payments of $850,962 and a final principal payment of $19,230,769. The present value of these cash flows at 3.80% = 7.60%/2 is $20,046,721. At the current exchange rate of CHF1.45/$, this Swiss franc value of the dollar present value is

\[
\text{CHF1.45} \times \frac{\text{CHF20,046,721}}{\text{USD}} = \text{CHF29,067,746}
\]

You are also scheduled to receive eight additional semi-annual payments of CHF656,250 and a final principal payment of CHF25,000,000. The present value of these cash flows at 3.375% = 6.75%/2 is CHF23,704,383. Thus, you can close out the swap if you make a net payment of

\[
\text{CHF29,067,746} - \text{CHF23,704,383} = \text{CHF5,363,363}
\]

You have to pay to close out the swap because the interest rate on dollars, which is what you are paying, has fallen; the interest rate on Swiss francs, which is what you are receiving, has risen; and the dollar has weakened relative to the Swiss franc. Each of these changes causes the swap to decrease in value from your perspective.