FINA2204 Tutorial 6: Currency swaps

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Reminder:

The mid-semester test contributes 35% towards your final grade and covers material from lectures 1 - 6.

- Time:
- Friday 12 September, 6.00pm - 8.00pm
- Venues:
- All students, with the exception of those who have a UniAccess Academic Adjustment Plan (UAAP), will sit their test in Wesfarmers Lecture Theatre (BUSN 441: G91). Students with a UAAP will sit their test in the Fox Lecture Hall (ARTS 106: G59). Students should bring their ID card and be ready to be admitted to their test venue at 6pm.
- Format of Test:
- The test will be of 90 minutes duration and will comprise:
- * 25 multiple choice questions , each worth 1 mark (25 marks)
- * one question where students are required define any five of eight terms, each worth 1 mark (5 marks)
- * one multi-part question based on material in either lecture 3 or lecture 4 (10 marks)
- * one multi-part question based on material in either lecture 5 or lecture 6 (10 marks)
- The test is out of a total of 50 marks.
- Students are permitted a UWA-approved calculator and one single-sided A4 page of notes, typed or handwritten. A formula sheet will be attached to the test paper.

Agenda

- Problem 7.3
- Problem 7.5
- Problem 7.15
- Problem 7.24
- Problem 7.25

Recap: definition

- *(Fixed-for-fixed) currency swaps* involves exchanging principal and interest payments at a fixed rate in one currency for principal and interest payments at a fixed rate in another currency (textbook, p.193).
- A currency swap agreement requires the principal to be specified in each of the two currencies.
- The principal amounts in each currency are usually exchanged at the beginning and at the end of the life of the swap.

Recap: definition

- Usually the principal amounts are chosen to be approximately equivalent using the exchange rate at the swap's initiation. But when they are exchanged at the end of the life of the swap, their values may be **quite different** (e.g., interest rate differential).
- Example

1. At initiation (t=0)

- Party A gives USD 10M to Party B;
- Party B gives JPY 1.5B to Party A.
- Exchange rate: 1 USD = 150 JPY

Recap: definition

- At maturity (t=T)
- According to the swap, the same principals (1 USD = 150 JPY) must be re-exchanged at the original rate:

1. Party A returns JPY 1.5B and receives USD 10M;
2. Party B returns USD 10M and receives JPY 1.5B.

- But suppose the market exchange rate has moved to 1 USD = 120 JPY (USD depreciation).
- Now, USD 10M is worth only JPY 1.2B in the market,
- While the contract still forces the exchanges of JPY 1.5B.

Recap: definition

- The swap's value is no longer zero, but has shifted in favor of one party (here, the USD payer, aka. party B).
- Roughly speaking, Party B makes a gain of USD 2.5M (=1.5B/**120**-10M). This amount is exactly the value of the swap to Party B at maturity, because the only remaining effect of the swap is the re-exchange of principals.
- For current point in time (before maturity), this back-of-the-envelop figure is only approximate, but it gives the right order of magnitude for the swap's value.

Recap: comparative advantage

Currency swaps can be motivated by comparative advantage. To illustrate this, we consider another hypothetical example. Suppose the five-year fixed-rate borrowing costs to General Electric and Qantas Airways in U.S. dollars (USD) and Australian dollars (AUD) are as shown in Table 7.6. The data in the table suggest that Australian rates are higher than U.S. interest rates. Also, General Electric is more creditworthy than Qantas Airways, because it is offered a more favorable rate of interest in both currencies. From the viewpoint of a swap trader, the interesting aspect of Table 7.6 is that the spreads between the rates paid by General Electric and Qantas Airways in the two markets are not the same. Qantas Airways pays 2% more than General Electric in the USD market and only 0.4% more than General Electric in the AUD market.

Table 7.6 Borrowing rates providing basis for currency swap

	*USD**	*AUD**
General Electric	5.0%	7.6%
Qantas Airways	7.0%	8.0%

*Quoted rates have been adjusted to reflect the differential impact of taxes.

Comparative advantage?
GE: in USD markets
QA: in AUD markets

Source: p.194

We suppose that General Electric wants to borrow 20 million AUD and Qantas Airways wants to borrow 15 million USD and that the current exchange rate (USD per AUD) is 0.7500. This creates a perfect situation for a currency swap. General Electric and Qantas Airways each borrow in the market where they have a comparative advantage; that is, General Electric borrows USD whereas Qantas Airways borrows AUD. They then use a currency swap to transform General Electric's loan into a AUD loan and Qantas Airways' loan into a USD loan.

There are many ways in which the swap can be arranged. Figure 7.11 shows one way a swap might be brokered by a financial institution. General Electric borrows USD and Qantas Airways borrows AUD. The effect of the swap is to transform the USD interest rate of 5% per annum to an AUD interest rate of 6.9% per annum for General Electric. As a result, General Electric is 0.7% per annum better off than it would be if it went directly to AUD markets. Similarly, Qantas exchanges an AUD loan at 8% per annum for a USD loan at 6.3% per annum and ends up 0.7% per annum better off than it would be if it went directly to USD markets. The financial institution gains 1.3% per annum on its USD cash flows and loses 1.1% per annum on its AUD flows. If we ignore the difference between the two currencies, the financial institution makes a net gain of 0.2% per annum. As predicted, the total gain to all parties is 1.6% per annum.

Each year the financial institution makes a gain of USD 156,000 (= 1.3% of 12 million) and incurs a loss of AUD 220,000 (= 1.1% of 20 million). The financial institution can avoid any foreign exchange risk by buying AUD 220,000 per annum in the forward market for each year of the life of the swap, thus locking in a net gain in USD.

Source: p.195

It is possible to redesign the swap so that the financial institution does not need to hedge. Figures 7.12 and 7.13 present two alternatives. These alternatives are unlikely to be used in practice because they do not lead to General Electric and Qantas being free of foreign exchange risk.[10] In Figure 7.12, Qantas bears some foreign exchange risk because

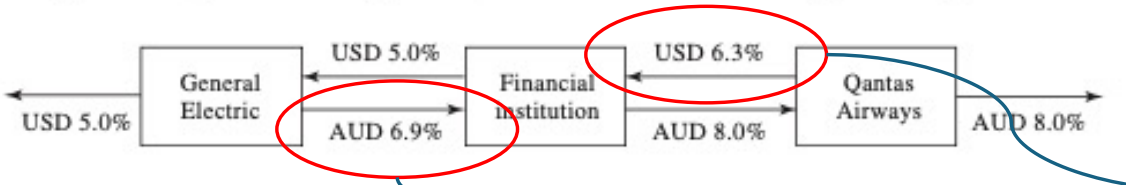


Figure 7.11 A currency swap motivated by comparative advantage

Both parties are **0.7%** per annum better off than if they go directly to market (USD 7% for QA / AUD 7.6% for GE).

Note: Usually, it makes sense for the financial institution to **bear** the foreign exchange risk, because it is in the best position to hedge the risk.

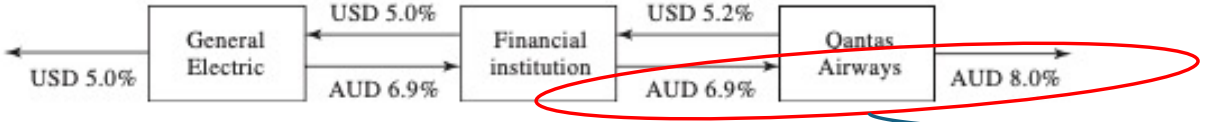


Figure 7.12 Alternative arrangement for currency swap: Qantas Airways bears some foreign exchange risk

QA faces FX risk: U 5.2% + A (8%-6.9%)

it pays 1.1% per annum in AUD and pays 5.2% per annum in USD. In Figure 7.13, General Electric bears some foreign exchange risk because it receives 1.1% per annum in USD and pays 8% per annum in AUD.

Figure 7.13 Alternative arrangement for currency swap: General Electric bears some foreign exchange risk

GE faces FX risk: A 8% + U (5%-6.1%)

Source: p.196

Problem 7.24

- *Company A, a British manufacturer, wishes to borrow U.S. dollars at a fixed rate of interest. Company B, a U.S. multinational, wishes to borrow sterling at a fixed rate of interest. They have been quoted the following rates per annum (adjusted for differential tax effects):*

	Sterling	*US Dollars*
Company A	*11.0%*	*7.0%*
Company B	*10.6%*	*6.2%*

- *Design a swap that will net a bank, acting as intermediary, 10 basis points per annum and that will produce a gain of 15 basis points per annum for each of the two companies.*

Answer 7.24

- 1. Basis: A has an apparent comparative advantage in the sterling market while B has an apparent comparative advantage in the U.S. dollar market. A borrows sterling at 11.0% and B borrows U.S. dollars at 6.2%. The spread between the interest rates offered to A and B is 0.4% (or 40 basis points) on sterling loans and 0.8% (or 80 basis points) on U.S. dollar loans. The total benefit to all parties from the swap is therefore 0.8% - 0.4% or 0.4% (or 40 basis points).

Answer 7.24

- It is therefore possible to design a swap which will earn 10 basis points for the bank while making each of A and B 15 basis points better off than they would be by going directly to financial markets.

	Sterling	*US Dollars*
Company A	*11.0%*	*7.0%*
Company B	*10.6%*	*6.2%*

Spread	0.4%	0.8%

differential=0.8%-0.4%=**0.4%**

Allocation (A/B/Bank): 0.15%/0.15%/0.1%

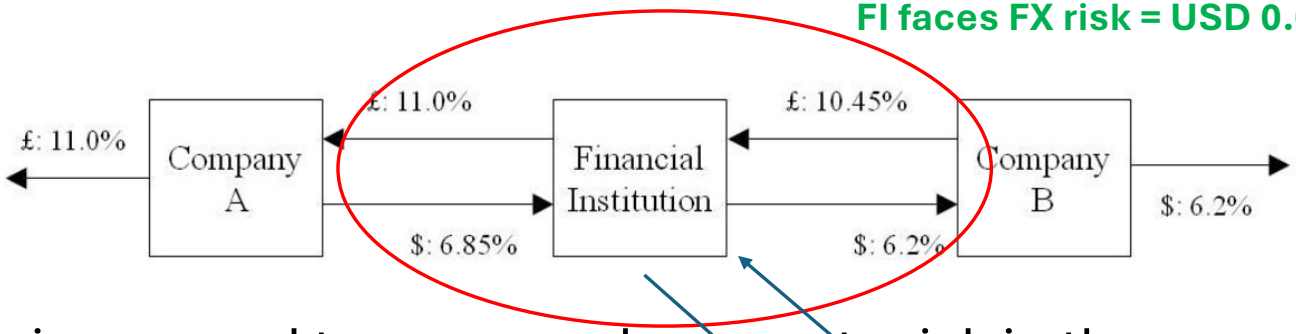
Answer 7.24

- 2. Swap terms: If **all** foreign exchange risk is borne by the bank then companies A and B must receive a cash inflow from the swap that exactly matches their borrowing costs. The swap terms that satisfy this condition are as follows:

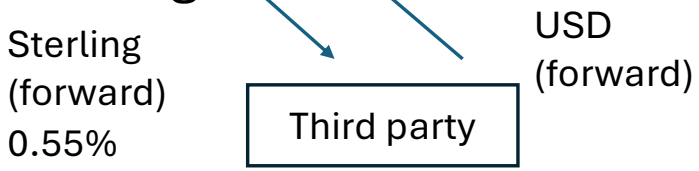
	Step	Company A	Company B
Funding:	1	£11.00%	$6.20%
Swap: Pay	5	$6.85	£10.45%
Receive		**£11.00%**	**$6.20%**
Net cost of funds	4	$6.85%	£10.45%
Direct cost	3	$7.00%	£10.60%
Saving	2	$0.15%	£0.15%

Answer 7.24

- <u>3. Design:</u> The swap should lead to A borrowing U.S. dollars at 7.00% – 0.15% = 6.85% per annum and to B borrowing sterling at 10.60% – 0.15% = 10.45% per annum. This arrangement is shown in the diagram below.



- The bank is exposed to some exchange rate risk in the swap. It earns 65 basis points in U.S. dollars and pays 55 basis points in sterling. This exchange rate risk could be hedged using forward contracts.



Problem 7.3

- *Company X wishes to borrow U.S. dollars at a fixed rate of interest. Company Y wishes to borrow Japanese yen at a fixed rate of interest. The amounts required by the two companies are roughly the same at the current exchange rate. The companies have been quoted the following interest rates, which have been adjusted for the impact of taxes:*

	Yen	US Dollars
Company X	5.0%	9.6%
Company Y	6.5%	10.0%

- *Design a swap that will net a bank, acting as intermediary, 50 basis points per annum. Make the swap equally attractive to the two companies and ensure that all foreign exchange risk is assumed by the bank.*

Answer 7.3

- 1. Basis: X has a comparative advantage in yen markets but wants to borrow dollars. Y has a comparative advantage in dollar markets but wants to borrow yen. This provides the basis for the swap. There is a 1.5% per annum differential between the yen rates and a 0.4% per annum differential between the dollar rates. The total gain to all parties from the swap is therefore 1.5 – 0.4 = 1.1% per annum. The bank requires 0.5% per annum, leaving 0.3% per annum for each of X and Y.

	yen markets	dollar markets
	Yen	US Dollars
Company X	5.0%	9.6%
Company Y	6.5%	10.0%
Spread	1.5%	0.4%

differential=1.5%-0.4%=**1.1%**

Allocation (A/B/Bank): 0.3%/0.3%/0.5%

Answer 7.3

- 2. Swap terms: If **all** foreign exchange risk is borne by the bank then companies X and Y must receive a cash inflow from the swap that exactly matches their borrowing costs. The swap terms that satisfy this condition are as follows:

	Step	Company X	Company Y
Funding:	1	¥5.0%	$10.0%
Swap: Pay	5	$9.30	¥6.2%
Receive		**¥5.0%**	**$10.0%**
Net cost of funds	4	$9.3%	¥6.2%
Direct cost	3	$9.6%	¥6.5%
Saving	2	0.3%	0.3%

Answer 7.3

- <u>3. Design:</u> The swap should lead to X borrowing dollars at 9.6% − 0.3% = 9.3% per annum and to Y borrowing yen at 6.5% − 0.3% = 6.2% per annum. This arrangement is shown in the diagram below.

Recap: valuation of currency swaps

- The value of current swap is the net present value (NPV) of the two cash flow streams that are being exchanged:
- Value of swap = PV (cash inflows) – PV (cash outflows)
- Each payment exchange = one forward contract
- Valuation assumes forward exchange rates are realized
- The cost of carry (COC) model in term of currency market

$$F_0 = S_0 e^{(r-r_f)T} \qquad (5.9)$$

where r and r_f are the domestic and foreign **continuously compounded (c.c)** risk-free rates.

Recap: valuation of currency swaps

1. Valuation in terms of forward rates

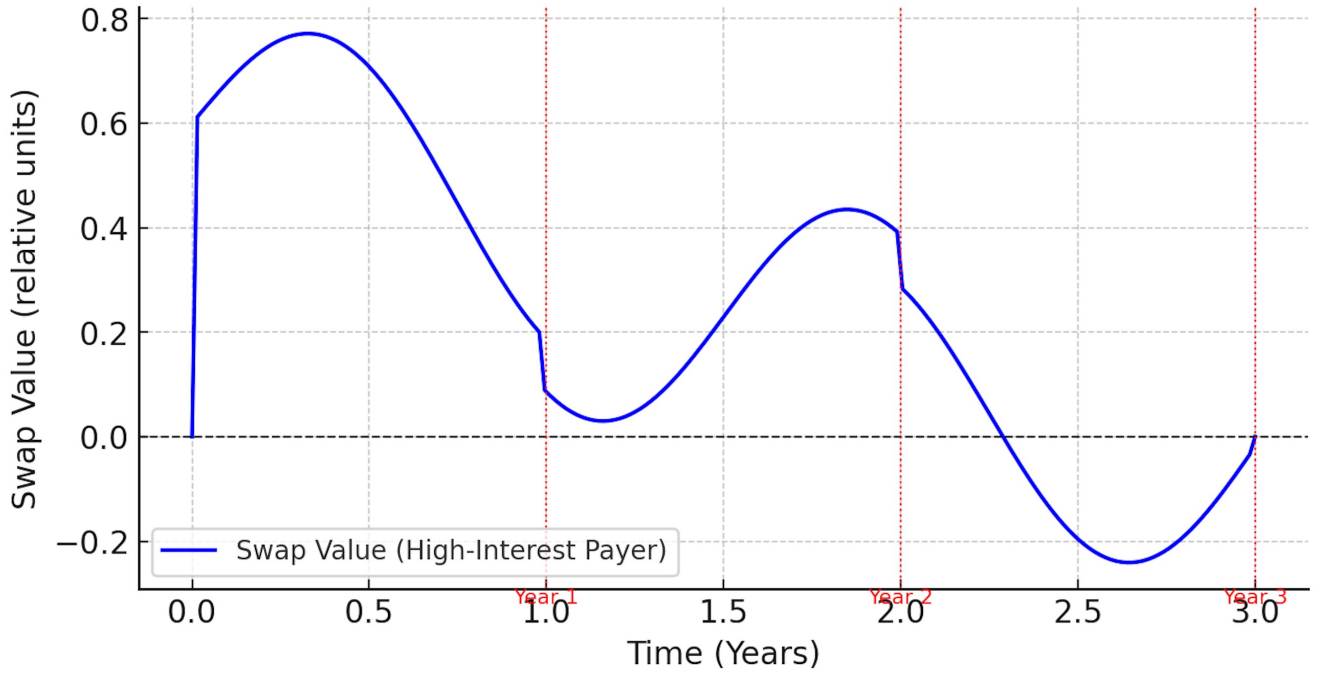
- Think of a currency swap as a **portfolio of forward contracts**.
- cash flow: the payer of the high-interest-rate currency is in the position where the forward contracts corresponding to the early exchanges of cash flows have negative values, and the forward contract corresponding to final exchange of principals has a positive value. The payer of the low-interest-rate currency is likely to be in the opposite position; that is, the early exchanges of cash flows have positive values and the final exchange has a negative value.

Recap: valuation of currency swaps

- Value of the swap: For the payer of the low-interest-rate currency, the swap will tend to have a negative value during most of its life. The forward contracts corresponding to the early exchanges of payments have positive values, and once these exchanges have taken place, there is a tendency for the remaining forward contracts to have, in total, a negative value. *For the payer of the high-interest-rate currency*, the reverse is true. **The value of the swap will tend to be positive during most of its life.** Results of this sort are important when the credit risk in bilaterally cleared transactions is considered.

Recap: valuation of currency swaps

- One possible value path for the payer of high-interest-rate currency



Recap: Example 7.3

Example 7.3 Valuing a fixed-for-fixed currency swap using forward rates

Suppose that the term structure of risk-free interest rates is flat in both Japan and the United States. The Japanese rate is 1.5% per annum and the U.S. rate is 2.5% per annum (both with continuous compounding). A financial institution has entered into a currency swap in which it receives 3% per annum in yen and pays 4% per annum in dollars once a year. The principals in the two currencies are $10 million and 1,200 million yen. The swap will last for another three years, and the current exchange rate is 110 yen per dollar. The calculations for valuing the swap as the sum of forward foreign exchange contracts are summarized in the following table (all amounts are in millions):

Time (years)	*Dollar cash flow*	*Yen cash flow*	*Forward exchange rate*	*Dollar value of yen cash flow*	*Net cash flow*	*Present value*
1	–0.4	+36	0.009182	0.3306	–0.0694	–0.0677
2	–0.4	+36	0.009275	0.3339	–0.0661	–0.0629
3	–10.4	+1236	0.009368	11.5786	+1.1786	+1.0934
Total						+0.9629

The financial institution pays $0.04 \times 10 = \$0.4$ million dollars and receives $1{,}200 \times 0.03 = 36$ million yen each year. In addition, the dollar principal of $10 million is paid and the yen principal of 1,200 is received at the end of year 3. The current spot rate is $1/110 = 0.009091$ dollar per yen. In this case, $r = 2.5\%$ and $r_f = 1.5\%$ so that the one-year forward exchange rate is, from equation (5.9), $0.009091e^{(0.025-0.015)\times 1} = 0.009182$. The two- and three-year forward exchange rates in the table are calculated similarly. The forward contracts underlying the swap can be valued by assuming that the forward exchange rates are realized. If the one-year forward exchange rate is realized, the value of yen cash flow in year 1 will be $36 \times 0.009182 = 0.3306$ million dollars and the net cash flow at the end of year 1 will be $0.3306 - 0.4 = -0.0694$ million dollars. This has a present value of $-0.0.0694e^{-0.025\times 1} = -0.0677$ million dollars. This is the value of the forward contract corresponding to the exchange of cash flows at the end of year 1. The value of the other forward contracts are calculated similarly. As shown in the table, the total value of the forward contracts is $0.9629 million.

Negative cash flow:
early exchange of interest payment

Positive cash flow:
final exchange of principal & interest

Recap: valuation of currency swaps

2. Valuation in terms of bond prices

- A fixed-for-fixed currency swap can also be valued in a straightforward way as **the difference between two bonds.**
- If we define V_{swap} as the value in U.S. dollars of an outstanding swap where dollars are received and a foreign currency is paid, that is,

$$V_{\text{swap}} = B_D - S_0 B_F$$

- where B_F is the value, measured in the foreign currency, of the bond defined by the foreign cash flows on the swap and B_D is the value of the bond defined by the domestic cash flows on the swap, and S_0 is the spot exchange rate.

Recap: valuation of currency swaps

- Similarly, the value of a swap where the foreign currency is received and dollars are paid is

$$V_{\text{swap}} = S_0 B_F - B_D$$

Example 7.4 Valuing a fixed-for-fixed currency swap using bonds

Consider again the situation in Example 7.3. The term structure of risk-free interest rates is flat in both Japan and the United States. The Japanese rate is 1.5% per annum and the U.S. rate is 2.5% per annum (both with continuous compounding). A financial institution has entered into a currency swap in which it receives 3% per annum in yen and pays 4% per annum in dollars once a year. The principals in the two currencies are $10 million and 1,200 million yen. The swap will last for another three years, and the current exchange rate is 110 yen = $1. The calculations for valuing the swap in terms of bonds are summarized in the following table (all amounts are in millions):

Long USD bond | Short JPY bond

Time (years)	*Cash flows on dollar bond ($)*	*Present value ($)*	*Cash flows on yen bond (yen)*	*Present value (yen)*
1	0.4	0.3901	36	35.46
2	0.4	0.3805	36	34.94
3	10.4	9.6485	1236	1181.61
Total		10.4191		1252.01

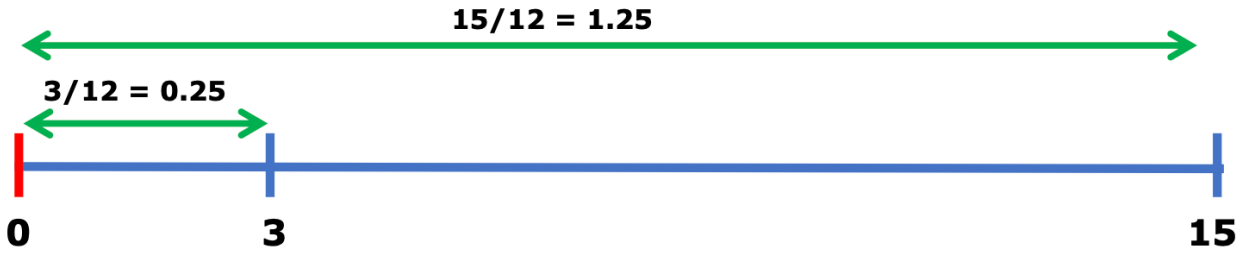
The cash flows from the dollar bond underlying the swap are as shown in the second column. The present value of the cash flows using the dollar discount rate of 2.5% are shown in the third column. The cash flows from the yen bond underlying the swap are shown in the fourth column. The present value of the cash flows using the yen discount rate of 1.5% are shown in the final column of the table. The value of the dollar bond, B_D, is 10.4191 million dollars. The value of the yen bond is 1,252.01 million yen. The value of the swap in dollars is therefore (1,252.01/110) − 10.4191 = 0.9629 million. This is in agreement with the calculation in Example 9.3.

Problem 7.5

- *A currency swap has a remaining life of 15 months. It involves exchanging interest at 10% on £20 million for interest at 6% on $30 million once a year. The term structure of risk-free interest rates in the United Kingdom is flat at 7% and the term structure of risk-free interest rates in the United States is flat at 4% (**both with annual compounding**). The current exchange rate (dollars per pound sterling) is 1.5500. What is the value of the swap to the party paying sterling? What is the value of the swap to the party paying dollars?*

Answer 7.5

- <u>1. Timeline:</u> The currency swap involves annual exchanges of interest and the exchange of the principal amounts at the end of the swap.



Principal ($m)	30
Principal (£m)	20
Fixed rate ($)	6.00%
Fixed rate (£)	10.00%
Riskfree ($)	4.00%
Riskfree (£)	7.00%
Spot rate (£)	1.5500

Converting from periodic compounding (R_m) to cont. compounding (R_c)

$$R_c = m \times ln\left(1 + \frac{R_m}{m}\right) \quad (4.3)$$

3.922% c.c.

6.766% c.c.

Answer 7.5

2. Forward rates approach

- For year 0.25
- $Cash\ inflow = 30 \times 6\% = \$1.8$
- $Cash\ outflow\ (in\ pound) = 10 \times 20\% = £2$
- $Forward\ exchange = 1.55 \times e^{(3.922\% - 6.766\%) \times 0.25} = 1.5390$
- $Cash\ outflow\ (in\ USD) = £2 \times 1.5390 = \$3.0780$
- $Net\ cash\ flow\ (in\ USD) = 1.8 - 3.0780 = \$ - 1.2780$
- $Discount\ factor = e^{-3.922\% \times 0.25} = 0.9902$
- $PV\ of\ net\ cashflow = -1.2780 \times 0.9902 = -1.2656$

Answer 7.5

- For year 1.25 (at maturity)
- $Cash\ inflow = 30\times6\% + 30 = \$31.8$
- $Cash\ outflow\ (in\ pound) = 10\times20\% + 20 = £22$
- $Forward\ exchange = 1.55\times e^{(3.922\%-6.766\%)\times1.25} = 1.4959$
- $Cash\ outflow\ (in\ USD) = £22\times1.4959 = 32.9091$
- $Net\ cash\ flow\ (in\ USD) = 31.8 - 32.9091 = \$ - 1.1091$
- $Discount\ factor = e^{-3.922\%\times1.25} = 0.9521$
- $PV\ of\ net\ cashflow = -1.1091\times0.9521 = -1.0561$

Answer 7.5

- $Value\ of\ swap = -1.2656 - 1.0561 = -2.3216$

Time (Years)	$ cash flow	£ cash flow	Forward exchange rate	$ value of £ cash flow	Net cash flow	Discount factor	PV of net cash flow
0.25	1.80	-2.00	1.5390	-3.0780	-1.2780	0.990243	-1.2656
1.25	31.80	-22.00	1.4959	-32.9091	-1.1091	0.952156	-1.0561
						Value of swap	-2.3216

- In contrast, the value of the swap to the party paying dollars is 2.3216.

Answer 7.5

3. Bond prices approach

- Alternatively, we can value the swap as the difference between the value of two bonds. The party paying sterling is **short a sterling bond and long a US dollar bond**.
- For US dollar bond
- At year 0.25
- $Cash\ inflow = 30 \times 6\% = \$1.8$
- $e^{-3.922\% \times 0.25} = 0.9902$
- $PV\ of$ cash inflow $= 1.8 \times 0.9902 = 1.782$

Answer 7.5

- At year 1.25
- $Cash\ inflow = 30 \times 6\% + 30 = \$31.8$
- $e^{-3.922\% \times 1.25} = 0.9521$
- $PV\ of$ cash inflow $= 31.8 \times 0.9521 = 30.279$
- $Value\ of$ US bond $= 1.782 + 30.279 = 32.061$

Answer 7.5

- Similarly, for sterling bond
- At year 0.25
- $Cash\ outflow = 20 \times 10\% = £2$
- $e^{-6.766\% \times 0.25} = 0.9832$
- At year 1.25
- $Cash\ outflow = 20 \times 10\% + 20 = £22$
- $e^{-6.766\% \times 1.25} = 0.9189$
- $Value\ of$ sterling bond $= 2e^{-6.766\% \times 0.25} + 22e^{-6.766\% \times 1.25} = £22.182$

Answer 7.5

- Using this equation,

$$V_{\text{swap}} = B_D - S_0 B_F$$

- The value of the swap to the party paying sterling (in millions of US dollars) is therefore the value of the US dollar bond less the value of the sterling bond i.e.
- $32.061 - 22.182 \times \mathbf{1.55} = -2.322$
- or –$2.322 million. For the party paying dollars, the value of the swap is $2.322 million.

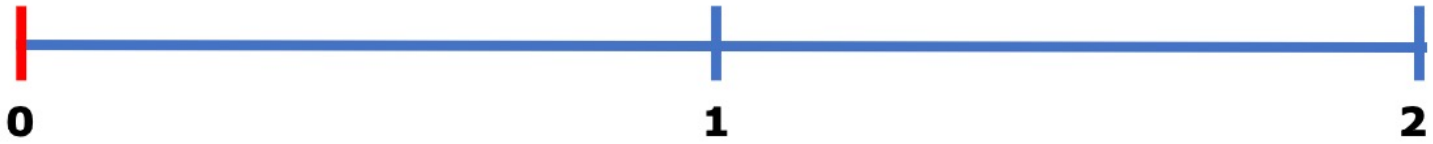
Time	US$ cash flow	US$ discount factor	PV of US$ cash flow	Sterling cash flow	Sterling discount factor	PV of sterling cash flow	
0.25	1.80	0.990243	1.782	2.00	0.983228	1.966	
1.25	31.80	0.952156	30.279	22.00	0.918904	20.216	
		US$ bond	32.061		Sterling bond	22.182	Sterling
					Sterling bond	34.383	US$

Problem 7.25

- *Suppose that the term structure of risk-free interest rates is flat in the United States and Australia. The USD interest rate is 7% per annum and the AUD rate is 9% per annum. The current value of the AUD is 0.62 USD. Under the terms of a swap agreement, a financial institution pays 8% per annum in AUD and receives 4% per annum in USD. The principals in the two currencies are $12 million USD and 20 million AUD. Payments are exchanged every year, with one exchange having just taken place. The swap will last two more years. What is the value of the swap to the financial institution? Assume* ***all interest rates are continuously compounded.***

Answer 7.25

- 1. Timeline



Principal (USDm)	12
Principal (AUDm)	20
Fixed rate (USD)	4.00%
Fixed rate (AUD)	8.00%
Riskfree (USD)	7.00%
Riskfree (AUD)	9.00%
Spot rate (AUD)	0.6200

Answer 7.25

2. Forward rates approach

- For year 1
- $Cash\ inflow = 12 \times 4\% = \$0.48$
- $Cash\ outflow\ (in\ A\$) = 20 \times 8\% = A\$1.6$
- $Forward\ exchange = 0.62 \times e^{(7\% - 9\%) \times 1} = 0.6077$
- $Cash\ outflow\ (in\ \$) = A\$\ 1.6 \times 0.6077 = \$0.9724$
- $Net\ cash\ flow\ (in\ \$) = 0.48 - 0.9724 = \$ - 0.4924$
- $Discount\ factor = e^{-7\% \times 1} = 0.9324$
- $PV\ of\ net\ cashflow = -0.4924 \times 0.9324 = -0.4591$

Answer 7.25

- For year 2 (at maturity)
- $Cash\ inflow = 12\times4\% + 12 = \$12.48$
- $Cash\ outflow\ (in\ A\$) = 20\times8\% + 20 = A\$\ 21.6$
- $Forward\ exchange = 0.62\times e^{(7\%-9\%)\times2} = 0.5957$
- $Cash\ outflow\ (in\ \$) = 21.6\times0.5957 = 12.8669$
- $Net\ cash\ flow\ (in\ USD) = 12.48 - 12.8669 = \$ - 0.3869$
- $Discount\ factor = e^{-7\%\times2} = 0.8694$
- $PV\ of\ net\ cashflow = -0.3869\times0.8694 = -0.3363$

Answer 7.25

- $Value\ of\ swap = -0.4591 - 0.3363 = -0.7954$

Time (Years)	US$ cash flow	A$ cash flow	A$ forward exchange rate	US$ value of A$ cash flow	Net cash flow	Discount factor	PV of net cash flow
1.00	0.48	-1.60	0.6077	-0.9724	-0.4924	0.932394	-0.4591
2.00	12.48	-21.60	0.5957	-12.8669	-0.3869	0.869358	-0.3363
						Value of swap	-0.7954

Answer 7.25

3. Bond prices approach

- Alternatively, we can value the swap as the difference between the value of two bonds. The financial institution is **long a USD bond and short an AUD bond**.
- For US dollar bond
- $PV\ of$ cash inflow at year $1 = 12\times4\%\times e^{-7\%\times1}$
- $PV\ of$ cash inflow at year $2 = (12\times4\% + 12)\times e^{-7\%\times2}$
- $Value\ of\ USD\ bond = 12\times4\%\times e^{-7\%\times1} + (12\times4\% + 12)\times e^{-7\%\times2} = 11.297$

Answer 7.25

- For AUD bond
- $PV\ of$ cash inflow at year $1 = 20\times 8\%\times e^{-9\%\times 1}$
- $PV\ of$ cash inflow at year $2 = (20\times 8\% + 20)\times e^{-9\%\times 2}$
- $Value\ of\ AUD\ bond = 20\times 8\%\times e^{-9\%\times 1} + (20\times 8\% + 20)\times e^{-9\%\times 2} = 19.504$

$$V_{\text{swap}} = B_D - S_0 B_F$$

- $Value\ of\ the\ swap = 11.297 - 19.504\times \mathbf{0.62} = -0.795$

Answer 7.25

Time Years)	US$ cash flow	US$ discount factor	PV of US$ cash flow	A$ cash flow	A$ discount factor	PV of A$ cash flow	
1.00	0.48	0.932394	0.447	-1.60	0.913931	-1.462	
2.00	12.48	0.869358	10.850	-21.60	0.835270	-18.042	
		US$ bond	11.297		A$ bond	-19.504	A$
					A$ bond	-12.092	US$

Recap: swaps, forwards and futures

- Similarities across swaps, forwards and futures

1. All are derivative contracts, whose value is derived from and underlying variable (interest rate, exchange rates, asset prices);
2. All can be used for hedging risk (interest rate risk, FX risk, price risk) or for speculation;
3. All involve **obligations** (not option): both parties are committed to honor the agreement;
4. All require market-to-market valuation: their fair value changes over time as market condition evolve.

Recap: swaps, forwards and futures

- Comparison table

Feature	Interest rate swap	Currency swap	Forwards / Futures
Principal	Not exchanged (notional principal / notional)	Physically exchanged at start & maturity	One settlement （physical delivery or cash settlement)
Cash flows	Fixed ↔ Floating	Fixed-for-fixed (interest & principal in different currencies)	Single payoff
Cash flow frequency	Multiple times	Multiple times	Single time
Nature	OTC	OTC	Forwards=OTC Futures=standardized, exchange-traded

Recap: credit risk

- Why bank's loss on swaps is **smaller** than loans

1. Regulation after GFC

- Central clearning parties (ccps) introduced;
- Initial margin required;
- Collateral agreements → bank only loses if exposure > collateral

2. Nature of interest rate swaps

- No principal exchanged, only interest differentials;
- Exposure = market-to-market value, a small fraction of notional principal

Problem 7.15

- *Why is the expected loss to a bank from a default on a swap less than the expected loss from the default on a loan to the counterparty with the same principal? Assume no other transactions between the bank and the counterparty, that the swap is cleared bilaterally, and that no collateral is provided by the counterparty in the case of either the swap or the loan.*

Answer 7.15

- In an interest-rate swap a financial institution's exposure depends on the difference between a fixed-rate of interest and a floating-rate of interest. It has no exposure to the notional principal. In a loan the whole principal can be lost.