Chapter Objective:

This chapter discusses various methods available for the management of transaction exposure facing multinational firms.
1. HOW to hedge
- Forward Market Hedge
  - Mechanics of “commodity”-settled vs. NDF hedges
- Money Market Hedge
- Options Market Hedge (NOT Exam Material)
  - Hedging Contingent Exposure
- Cross-Hedging Minor-Currency Exposure
- Hedging Recurrent Exposure with Swap Contracts
- Hedging techniques for smaller firms? (NOT Exam Material)
  - Hedging Through Invoice Currency? Hedging via Lead / Lag?

2. WHAT (i.e., how much) to hedge
- Exposure Netting

3. WHETHER to hedge
- Should the Firm Hedge IN THE FIRST PLACE?
- What Risk Management Products do Firms Use?
  - And, how much do they hedge?
1. HOW?

1a. Forward Hedge
Forward Market Hedge

- If you are going to owe foreign currency in the future, agree to buy the foreign currency now by entering into long position in a forward contract.
  - You are short the underlying → go long forward
- If you are going to receive foreign currency in the future, sell the foreign currency now by entering into short position in a forward contract.
  - You are long the underlying → go short forward

Forward Market Hedge: an Example

You are a U.S. importer of British woolens and have just ordered next year’s inventory. Payment of £100M is due in one year.

Question: How can you fix the cash outflow in dollars?

Answer: One way is to put yourself in a position that delivers £100M in one year—a long forward contract on the pound.
### Forward Market Hedge

**Suppose the forward exchange rate is $1.50/£.**

If he does not hedge the £100m payable, in one year his gain (loss) on the unhedged position is shown in green.

<table>
<thead>
<tr>
<th>Unhedged payable</th>
<th>$1.50/£</th>
<th>$1.20/£</th>
<th>$1.80/£</th>
<th>Value of £1 in $ in one year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30 m gain</td>
<td>$0</td>
<td>$30 m</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

The importer will be better off if the pound depreciates: he still buys £100 m but at an exchange rate of only $1.20/£ he saves $30 million relative to $1.50/£.

But he will be worse off if the pound appreciates.

---

**If he agrees to buy £100m in one year at $1.50/£ his gain (loss) on the forward are shown in blue.**

<table>
<thead>
<tr>
<th>Long forward</th>
<th>If you agree to buy £100 million at a price of $1.50 per pound, you will make $30 million if the price of a pound reaches $1.80.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$30 m</td>
<td>$0</td>
</tr>
<tr>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>$-30 m</td>
<td>$0</td>
</tr>
</tbody>
</table>

If you agree to buy £100 million at a price of $1.50 per pound, you will lose $30 million if the price of a pound is only $1.20.
Forward Market Hedge

The red line shows the payoff of the hedged payable. Note that gains on one position are offset by losses on the other position.

1b. Money-Market Hedge
This is the same idea as covered interest arbitrage.

To hedge a foreign currency payable, buy a bunch of that foreign currency today and sit on it.

- It’s more efficient to buy the present value of the foreign currency payable today.
- Invest that amount at the foreign rate.
- At maturity your investment will have grown enough to cover your foreign currency payable.

The importer of British woolens can hedge his £100 million payable with a money market hedge:

1. Borrow $112.05 million in the U.S.
2. Translate $112.05 million into pounds at the spot rate $S(\$/£) = $1.25/£$
3. Invest £89.64 million in the UK at $i_e = 11.56\%$ for 1 year.

In one year the investment will have grown to £100 million.

<table>
<thead>
<tr>
<th>Spot exchange rate</th>
<th>$S($/£) \quad = \quad $1.25/£</th>
</tr>
</thead>
<tbody>
<tr>
<td>360-day forward rate</td>
<td>$F_{360}($/£) \quad = \quad $1.20/£</td>
</tr>
<tr>
<td>U.S. discount rate</td>
<td>$i_d \quad = \quad 7.10%</td>
</tr>
<tr>
<td>British discount rate</td>
<td>$i_e \quad = \quad 11.56%</td>
</tr>
</tbody>
</table>
Money-Market Hedge

Where do the numbers come from?
We owe our supplier £100 million in one year—so we know that we need to have an investment with a future value of £100 million. Since \( i_e = 11.56\% \) we need to invest £89.64 million at the start of the year:

\[
£89.64 = \frac{£100}{1.1156}
\]

How many dollars will it take to acquire £89.64 million at the start of the year if the spot rate \( S(\$/£) = $1.25/£ \)?

\[
$112.05 = £89.64 \times \frac{$1.25}{£1.00}
\]

Money-Market Hedge

If we borrow $112.05 today one year later we will owe $120 in one year:

\[
$120 = $112.05 \times (1.071)
\]

With this money market hedge, we have redenominated our £100 payable into a $120 payable.
Money-Market Hedge: Step One

Suppose you want to hedge a payable in the amount of £\(y\) with a maturity of \(T\):

i. Borrow \(\$x\) at \(t = 0\) on a loan at a rate of \(i_{\£}\) per year.

\[
\$x = S(\$/\£) \times \frac{\£y}{(1 + i_{\£})^T}
\]

\(\$$
\xrightarrow{\text{Repay the loan in } T \text{ years}}
\xrightarrow{\text{\$$}(1 + i_{\£})^T}
\]

Money-Market Hedge: Step Two

ii. Exchange the borrowed \(\$x\) for \(\frac{\£y}{(1 + i_{\£})^T}\) at the prevailing spot rate.

Invest \(\frac{\£y}{(1 + i_{\£})^T}\) at \(i_{\£}\) for the maturity of the payable.

At maturity, you will owe a \(\$$x(1 + i_{\£})^T\).
Your British investments will have grown to £\(y\). This amount will service your payable and you will have no exposure to the pound.
Money-Market Hedge

1. Calculate the present value of £\( y \) at \( i_\ell \)
   \[
   \frac{\£ y}{(1 + i_\ell)^T}
   \]

2. Borrow the U.S. dollar value of receivable at the spot rate.

3. Exchange \( \$ x = S(\$/\£) \times \frac{\£ y}{(1 + i_\ell)^T} \) for \( \frac{\£ y}{(1 + i_\ell)^T} \)

4. Invest \( \frac{\£ y}{(1 + i_\ell)^T} \) at \( i_\ell \) for \( T \) years.

5. At maturity your pound sterling investment pays your receivable.

6. Repay your dollar-denominated loan with \( \$ x(1 + i_\ell)^T \).

1c. Options (NOT Exam Material)
Hedging Contingent Exposure

- If only certain contingencies give rise to exposure, then options can be effective insurance
- Example
  - if your firm is bidding on a hydroelectric dam project in Canada, you will need to hedge the Canadian-U.S. dollar exchange rate only if your bid wins the contract
- Hedge such contingent FX risk with FX options

Options Market Hedge

(Not Exam Material)

- Options provide a flexible hedge against the downside, while preserving the upside potential.
- To hedge a possible foreign currency payable, buy calls on the currency.
  - If the currency appreciates, your call option lets you buy the currency at the exercise price of the call.
- To hedge a possible foreign currency receivable, buy puts on the currency.
  - If the currency depreciates, your put option lets you sell the currency for the exercise price.
Options Market Hedge

Suppose the 1-year forward exchange rate is $1.50/£.
If an importer who owes £100m does not hedge the payable, in one year his gain/loss on the unhedged position is shown in green (his worry is if the pound appreciates).

$0
$30 m
$1.20/£
$1.50/£
$1.80/£
Spot in 1 year
(#$/£)

The importer will be better off if the pound depreciates: he still buys £100 m but at an exchange rate of only $1.20/£ he saves $30 million relative to $1.50/£.

But he will be worse off if the pound appreciates.

Unhedged payable

Unhedged cost ($ value of the £ payable)

Options Markets Hedge

Suppose our importer buys a call option on £100m with an exercise price of $1.50 per pound.
He pays $.05 per pound for the call.

Profit

$0
$5 m
$1.55/£
$1.50/£

Long call on £100m

Value of £1 in $ in one year
Options Markets Hedge

The payoff of the portfolio of a call and a payable is shown in red.

He can still profit from decreases in the exchange rate below $1.45/£ but has a hedge against unfavorable increases in the exchange rate.

If the exchange rate increases to $1.80/£ the importer makes $25 m on the call but loses $30 m on the payable for a maximum loss of $5 million.

This can be thought of as an insurance premium.
1d. Special Topics

a. Cross-Hedging
Minor Currency Exposure

- The major currencies are the: U.S. dollar, Euro, British pound, Japanese yen, Swiss franc, and Canadian dollar. In North America, the Mexican peso is also considered a major currency.
- Most everything else is a minor currency
  - It is difficult, expensive, or impossible to use financial contracts to hedge exposure to minor currencies;
  - Example: the Polish zloty
    - A zloty futures is traded on the IMM (ditto for the ruble, the Norwegian and Swedish Kr., etc.) – so where are the costs?
Cross-Hedging
Minor Currency Exposure

- Cross-Hedging involves hedging a position in one asset by taking a position in another asset.
- The effectiveness of cross-hedging depends upon how well the assets are correlated.
  - An example would be a U.S. importer with liabilities in Czech koruna hedging with long or short forward contracts on the euro. If the koruna is expensive when the euro is expensive, or even if the koruna is cheap when the euro is expensive it can be a good hedge. But they need to co-vary in a predictable way.

b. Hedging Recurrent Exposure with Swaps

- Recall that swap contracts can be viewed as a portfolio of forward contracts.
- Firms that have recurrent exposure can very likely hedge their exchange risk at a lower cost with swaps than with a program of hedging each exposure as it comes along.
- It is also the case that swaps are available in longer-terms than futures and forwards.
c. Hedging through Invoice Currency *(Not Exam Material)*

- The firm can *shift, share, or diversify*:
  - **shift exchange rate risk**
    - by invoicing foreign sales in home currency
    - by forcing suppliers to invoice in buyer’s home currency
  - **share exchange rate risk**
    - by pro-rating the currency of the invoice between foreign and home currencies.
  - **diversify exchange rate risk**
    - by using a market basket index. *(NEM)*

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d. “Hedging” *via* Lead and Lag *(Not Exam Material)*

- If a currency is appreciating, pay those bills denominated in that currency early; let customers in that country pay late as long as they are paying in that currency.

- If a currency is depreciating, give incentives to customers who owe you in that currency to pay early; pay your obligations denominated in that currency as late as your contracts will allow.
2. HOW MUCH?

Exposure Netting

- A multinational firm should not consider deals in isolation, but should focus on hedging the firm as a portfolio of currency positions.
- As an example, consider a U.S.-based multinational with Korean won receivables and Japanese yen payables. Since the won and the yen tend to move in similar directions against the U.S. dollar, the firm can just wait until these accounts come due and just buy yen with won.
- Even if it’s not a perfect hedge, it may be too expensive or impractical to hedge each currency separately.
Exposure Netting

- Many multinational firms use a **reinvoice center**. Which is a financial subsidiary that nets out the intrafirm transactions.
- Once the residual exposure is determined, then the firm implements hedging.

Exposure Netting: an Example

Consider a U.S. MNC with three subsidiaries and the following foreign exchange transactions:

- USD to CAD: $20 to $30
- USD to CAD: $40 to $10
- USD to CAD: $25 to $30
- USD to EUR: $20 to $60
- USD to EUR: $20 to $30
- CAD to EUR: $30 to $40
- CAD to EUR: $30 to $40
Exposure Netting: an Example

Bilateral Netting would reduce the number of foreign exchange transactions by half:

Original text:

Bilateral Netting would reduce the number of foreign exchange transactions by half:

\[
\begin{align*}
\text{US} & \quad \text{Canada} \\
\text{\$10} & \quad \text{\$20} \\
\text{\$35} & \quad \text{\$30} \\
\text{\$40} & \quad \text{\$25} \\
\text{\$60} & \quad \text{\$20} \\
\end{align*}
\]
Bilateral Netting would reduce the number of foreign exchange transactions by half:
Exposure Netting: an Example

Bilateral Netting would reduce the number of foreign exchange transactions by half:

- $10
- $35
- $10
- $25
- $60
- $30
- $40

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Exposure Netting: an Example

Bilateral Netting would reduce the number of foreign exchange transactions by half:

[Diagram showing bilateral netting with flags and currency amounts]

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Exposure Netting: an Example

Bilateral Netting would reduce the number of foreign exchange transactions by half:

![Diagram showing bilateral netting example]
Exposure Netting: an Example

Bilateral Netting would reduce the number of foreign exchange transactions by half:

United States (US) $25

Canada $25

Germany $25

United Kingdom (UK) $25

American $10

Canadian $10

German $10

British $10

Exposure Netting: an Example

Bilateral Netting would reduce the number of foreign exchange transactions by half:

United States (US) $25

Canada $25

Germany $25

United Kingdom (UK) $25

American $10

Canadian $10

German $10

British $10
Consider simplifying the bilateral netting with multilateral netting:

Exposure Netting: an Example

Exposure Netting: an Example
Exposure Netting: an Example

Consider simplifying the bilateral netting with multilateral netting:

- $15
- $20
- $15
- $10
- $10
- $10

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Exposure Netting: an Example

Consider simplifying the bilateral netting with multilateral netting:

- **$15** (US) → **$10** (Canada) → **$30** (Germany) → **$15** (UK) → **$10** (US)
Exposure Netting: an Example

Consider simplifying the bilateral netting with multilateral netting:

![Diagram showing bilateral netting with multilateral netting with flags representing different countries and corresponding financial amounts.]

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Exposure Netting: an Example

Consider simplifying the bilateral netting with multilateral netting:

- $10
- $15
- $30

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Consider simplifying the bilateral netting with multilateral netting:

Exposure Netting: an Example

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Exposure Netting: an Example

Consider simplifying the bilateral netting with multilateral netting:

$15

$40

Clearly, multilateral netting can simplify things greatly.

$15

$40
Exposure Netting: an Example

Compare this:

Exposure Netting: an Example

With this:
3. WHETHER?

Should the Firm Hedge?

- Not everyone agrees that a firm should hedge:
  - Investors?
    - Hedging by the firm may not add to shareholder wealth if the shareholders can manage the FX exposure themselves
    - Hedging may not reduce the non-diversifiable risk of the firm. Therefore shareholders who hold a diversified portfolio are not helped when management hedges
  - COO: Hedging may increase (economic) risk if competitors don’t hedge
Should the Firm Hedge?

- In the presence of *market imperfections*, the firm should hedge.
  - Information Asymmetry
    - The managers may have better information than the shareholders.
  - Differential Transactions Costs
    - The firm may be able to hedge at better prices than the shareholders.
  - Default Costs
    - Hedging may reduce the firm’s cost of capital if it reduces the probability of default.

Taxes can be a large market imperfection.
- Corporations that face progressive tax rates may find that they pay less in taxes if they can manage earnings by hedging than if they have “boom and bust” cycles in their earnings stream.

Empirical evidence on the benefits of hedging
- Allayanis & Weston, *RFS’* 01 (hedging adds 5% to firm value)
- Guay & Khotari, *JFE’* 03: This can’t be right.
4. What Risk Management Products do Firms Use?

- Most U.S. firms meet their exchange risk management needs with forward, swap, and options contracts.
- The greater the degree of international involvement, the greater the firm’s use of foreign exchange risk management.
- The proof is in the pudding
  - 90+% of the world’s Top-500 companies hedge, mostly FX risk.

End Chapter Eight