This chapter serves to introduce students to the institutional framework within which exchange rates are determined. This chapter lays the foundation for much of the discussion throughout the remainder of the text, thus it deserves your careful attention.
The Function and Structure of the FOREX Market

- FOREX Market Participants
- Correspondent Banking Relationships

FOREX Market Participants

- The FOREX market is a two-tiered OTC market:
  - Interbank Market (Wholesale)
    - About 700 banks worldwide stand ready to make a market in FOREIGN EXchange (max. 100-200 active)
    - “Other FIs” now make up 53% of the market (HFs,...)
    - There are FX brokers who match buy and sell orders but do not carry inventory and FX specialists (dwindling importance).
  - Client Market (Retail: 9% of total; 14% in ’04 & ’10; 18% in ’07)
  - Market participants include international banks, their customers, nonbank dealers, forex brokers (e.g., ICAP), and central banks.

FOREX Market Structure

- OTC:
  - Main center is UK – London (41% of turnover in 2013)
    - + NY (19%), Tokyo (6%), S’pore (6%), HK (5%), Zurich (4%)
  - Tight infrastructure (communication, netting, clearing)
- Compartments
  - Spot = 38% of turnover (up 1% from 2010)
  - Outright Forwards = 13% of turnover (stable since 2010)
  - FX swaps = 42% of turnover (down 14% from 2007)
- Banks < 39%, Other FIs < 53%, Retail < 9%

Circadian Rhythms of the FX Market

“Plumbing” of the Interbank Market
**Foreign Exchange Settlement**

![Diagram](https://example.com/diagram.png)

- A Sells Yen to B
- B pays A in Can $

**Bank A**
- Bank B's nostro bank (Japan)

**Bank B**
- Bank A's nostro bank (Canada)

**Types of Risks in FX Transactions**

- **Banker risk**
  - Bank where settlement account is held becomes insolvent

- **Credit risk**
  - Counterparty will not settle (now or later)
    - Liquidity & Replacement risk (“not now but later”)
    - Principal risk

- **“Herstatt” risk**
  - FX settlement risk
  - Principal risk
  - Type of credit risk

- **Operational risk**

- **Systemic risk**
  - Risk of domino effect

**“Plumbing”/Back-office issues**

- International commercial banks communicate/settle/clear:
  - **SWIFT**: Society for Worldwide Interbank Financial Telecommunication
    - Dec. 2013: 5,732 members & sub-members, 21.5m msgs/day (up)
  - **CLS Bank**: Continuous Linked Settlement eliminates settlement risk
    - Basic idea: net out payments, cut gross by 95%+ for 17 currencies
    - Typical day (34): 3300+ users, 1.2m payment instructions, gross $5.3tn
    - Reduces actual payments (in practice: net as small as 0.6% of gross)
      - **ECCH**: the precursor; Exchange Clearing House Limited, the first global clearinghouse for settling interbank FOREX transactions
      - **Clearing**: CHIPS: Clearing House Interbank Payments System (Sleg)
      - **TARGET** (Euro leg), **LVTS** (Canada), **BOJ-NET**, etc.
  - Payments: through network of correspondent banks.

**CLS Bank**

- **Plus (in practice)**: minimizes “Herstatt” risk
- **Minuses (in theory)**: systemic risk (opational risk, concentration to the 65 members) + liquidity risk (intraday payments are the norm for settlement members)

**Correspondent Banking Relationships**

- Large commercial banks maintain demand deposit accounts with one another which facilitates the efficient functioning of the forex market:
  - Nostro (“on us”) / vostro (“on you”) accounts
  - In practice, not all forex banks must have correspondent accounts
    - Some large traders are non-financial institutions
    - What matters is that they have a standing arrangement with a bank that has a network of correspondent banks.

**Example of Correspondent Banking Relationships**

<table>
<thead>
<tr>
<th>Bank A</th>
<th>Bank B</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>NYC</td>
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</table>

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>£ deposit at B</td>
<td>£100m</td>
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<tr>
<td>£ deposit at B</td>
<td>£200m</td>
</tr>
<tr>
<td>Other Assets</td>
<td>£1,300m</td>
</tr>
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<td>Total Assets</td>
<td>£1,300m</td>
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The Spot Market

- Spot Rate Quotations
- The Bid-Ask Spread
- Spot FX trading
- Cross Rates

Additional information:
- Canada (Dollar)
- Britain (Pound)
- Brazil (Real)
- Australia (Dollar)
- Argentina (Peso)

Cross Rates

The Bid-Ask Spread

Spot Rate Quotations

- 6 Months Forward
- 3 Months Forward
- 1 Month Forward

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<tr>
<td>Britain (Pound)</td>
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<tr>
<td>Canada (Dollar)</td>
<td>0.0057</td>
<td>0.0060</td>
<td>0.0088</td>
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Spot Rate Quotations

Direct quotation
- # of local currency units per 1 unit of foreign currency
- Example: in New York, the U.S. dollar equivalent of FX
  - e.g. “a Japanese Yen is worth about a penny”

Indirect Quotation
- # of units of foreign currency per 1 unit of local currency
- Example: in NY, the price of 1 US$ in foreign currency
  - e.g. “you get 100 yen to the dollar”

See the insert card from your textbook.

The Bid-Ask Spread

Spot Rate Quotations

- 6 Months Forward
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Spot Rate Quotations

Direct quote for the pound sterling in New York:
£1 = $1.9077

Indirect quote in New York:
£1.9077 = $1

Note that the direct quote is the reciprocal of the indirect quote:
1.9077 = \frac{1}{0.5242}
## Spot Rate Quotations

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<td>1 Month Forward</td>
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Note also that the direct quote in New York is the indirect quote in London, and vice-versa.

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## American terms
- # of $ per 1 unit of foreign currency
- Idea: direct quote in NY, hence “American”
- e.g. “a Japanese Yen is worth about a penny”
- Convention: interbank quotes for the €, £, A$, NZ$; also, currency option (PHLX, CME) & futures (CME) quotes

---

## European terms
- # of units of foreign currency per 1 $ (e.g. “you get about 100 yen to the dollar”)
- In NY, the price of a U.S. dollar in the foreign currency

---

## European quote for British pound is: £1 = $1.9077

---

## Note that the American quote = reciprocal of the European quote: $1.9077 = 1/0.5242
The Bid-Ask Spread

- The bid price is the price a dealer is willing to pay you for something.
- The ask price is the amount the dealer wants you to pay for the thing.
- The bid-ask spread is the difference between the bid and ask prices.
- Example: the Yen is quoted at 102.40-44

Units = ? ; Total bill to buy $10m = ? ; Mid-point = ?

A dealer could quote a bid price of $1.2739 per €

ask price of $1.2744 per €

While there are a variety of ways to quote that, the bid-ask spread represents the dealer’s expected profit.

Percent Spread = \( \frac{\text{Ask Price} – \text{Bid Price}}{\text{Ask Price}} \times 100 \)

Typical B-A spread is less than 5 pips for G10 currencies

Spot FX trading

- In the interbank market, a typical trade size may be about USD10 million.
- The stakes are high, the “long term” is about 10’
- Platforms: 85+% is anonymous limit B-A orders via…
  - Reuters: main platform for $/€
  - + C$ & A$ + Scandinavian + Chinese Renminbi (since 2006)
  - …EBS (Electronic Brokerage System)
  - <10% voice brokers in illiquid curr. (rest is Reuters chats)
  - Note: traders can get non-binding quotes (BB, Reuters)

Cross Rates

- Suppose that \( S(\$/€) = 1.5 \)
  - i.e. $1 = 0.6667 €
  - and that \( S(¥/€) = 150 \)
  - i.e. €1 = ¥150
  - What must the $/¥ cross rate be?

\[
\frac{S(\$/€)}{S(¥/€)} = \frac{\frac{\$}{€}}{\frac{¥}{€}}
\]

\[
$1.5 \times \frac{€1}{¥150} = \frac{\$1}{¥100} \Rightarrow S(\$/¥) = 0.1 or $1 = ¥100
\]
Cross Rates

- Quote convention?
  - Basic principle: quote in terms of the main currency
    - The same convention explains why most currencies are quoted in European terms against the U.S. dollar
    - Example: 120 Yen / 1 USD
  - What if the dollar is not involved?
    - If importance of the currencies differ:
      - Same idea: # minor currency / unit of the major currency
    - If two small currencies are involved:
      - Traders have been known to get confused – “did you just quote me the bid or the offer price?”

Triangular Arbitrage

Suppose we observe these banks posting these exchange rates.
First calculate any implied cross rate to see if an arbitrage exists.

Credit Lyonnais
- S(¥/$) = 2
- S(¥/£) = 245
Barclays
- S($/£) = 120
Credit Agricole
- S(¥/$) = 120

Suppose we observe these banks posting these exchange rates.
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- S($/£) = 120
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The implied S(¥/£) cross rate is S(¥/£) = 240

As easy as 1 – 2 – 3:
1. Sell the $ for £,
2. Sell the £ for ¥,
3. Sell the ¥ for $

But, how can we make money?
Sell the £ to CA @ ¥245; “buy” the £ @ implicit ¥240

Implementation in practice

- Risks?
  - Yes, though small
  - Why? physically impossible to execute all three transactions simultaneously  → quotes could change before the deal is set
- Example of triangular arb with B-A spreads
  - Q5 in PS8:1

Sell $200,000 for £ at S(£/$) = 2
receive £100,000

Sell these £ 100,000 for ¥ at S(¥/£) = 245
receive ¥24,500,000

Sell ¥24,500,000 for $ at S(¥/$) = 120
receive $204,167

profit per round trip = $204,167 - $200,000 = $4,167
Spot Foreign Exchange Microstructure

- Market Microstructure refers to the mechanics of how a marketplace operates.
- Bid-Ask spreads in the spot FX market:
  - increase with FX exchange rate volatility and
  - decrease with dealer competition.
  - example of cross rates and triangular arb with B-A’s
- Private information (about what?) is an important determinant of spot exchange rates.

The Forward Market

- Forward Rate Quotations
- Long and Short Forward Positions
- Forward Cross Exchange Rates
  - Basic idea – similar to spot cross rates
  - Numerical example with bid-ask prices (as time allows)
- FX Swap Transactions
- Forward Premium

The Forward Market

- An (outright) forward contract is an agreement to buy or sell an asset (e.g., a foreign currency) in the future at a price agreed upon today:
  - Similar in all respects to a spot contract;
    - The only difference is the delivery date.
  - Analogy: ordering an out-of-stock textbook=fwd contract
- Revised definition? Not so fast!
  - 2010: BIS included cash-settled forwards (NDF), CFDs
  - 2012: U.S. Treasury sharply differentiates (Dodd-Frank)

Spot Rate Quotations

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<td>3.0221</td>
<td>3.0377</td>
</tr>
<tr>
<td>Australia (Dollar)</td>
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<td>1.2771</td>
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<tr>
<td>Brazil (Real)</td>
<td>3.7235</td>
<td>3.7911</td>
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<td>Britain (Pound)</td>
<td>1.9077</td>
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<td>1.9044</td>
<td>1.9051</td>
<td>0.5231</td>
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<td>3 Months Forward</td>
<td>1.8983</td>
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<td>0.8067</td>
<td>0.8088</td>
<td>1.2432</td>
<td>1.2394</td>
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</tbody>
</table>

Forward Rate Quotations

Do market participants expect that the pound will be worth less in dollars in six months?

Consider the example from above:
for British pounds, the spot rate is $1.9077 = £1.00
while the 180-day forward rate is $1.8904 = £1.00

What’s up with that?
  - “Cost of carry”?
  - or Expectations?
Long and Short Forward Positions

- If you have agreed to sell anything (spot or forward), you are "short".
- If you have agreed to buy anything (forward or spot), you are "long".
- If you have agreed to sell forex forward, you are short.
- If you have agreed to buy forex forward, you are long.

Payoff Profiles

If you agree to sell anything in the future at a set price and the spot price later falls then you gain.

\[ \text{Short fwd Yen position} \]

\[ S_{180}(¥/$) \]

If you agree to sell anything in the future at a set price and the spot price later rises then you lose.

\[ F_{180}(¥/$) = 105 \]

When the short entered into this forward contract, he agreed to sell ¥ in 180 days at \( F_{180}(¥/$) = 105 \).

If, in 180 days, \( S_{180}(¥/$) = 120 \), the short will make a profit by buying ¥ at \( S_{180}(¥/$) = 120 \) and delivering ¥ at \( F_{180}(¥/$) = 105 \).

Since this is a zero-sum game, the long position payoff is the opposite of the short.
Payoff Profiles

The long in this forward contract agreed to BUY ¥ in 180 days at $F_{180}(¥/$) = 105.

If, in 180 days, $S_{180}(¥/$) = 120, the long will lose by having to buy ¥ at $S_{180}(¥/$) = 120 and delivering ¥ at $F_{180}(¥/$) = 105.

Profit:

$F_{180}(¥/$) = 105

Loss:

$S_{180}(¥/$) = 120

Forward Cross Exchange Rates

• It's just a “delayed version” of the spot cross rate example discussed above.

• In generic terms

\[
F_S(j/k) = \frac{F_S(S/j)}{F_S(S/k)}
\]

and

\[
F_S(k/j) = \frac{F_S(S/j)}{F_S(S/k)}
\]

Cross Quotes & Triangular Arbitrage

• Practical example

You observe the following 1-months forward rates:

- 1.6005-35 SF/$ in Zurich
- 1.9815-00 $/£ in NY

a. As a banker in London, you would like to quote a £/SF cross-rate for the SF (i.e., #£/1SF). If you expected to be the sole banker in the world quoting this forward cross-rate, what would your quote be?

b. In reality, you have 10 competitors who stand ready to quote this cross rate. Suppose that all those banks have, like yours, operating costs of approximately 0.05% of volume. Would this affect your answer?

Currency Symbols

• In addition to the familiar currency symbols (e.g., £, ¥, €, $) there are three-letter codes for all currencies. It is a long list, but selected codes include:

- CHF Swiss francs
- GBP British pound
- ZAR South African rand
- CAD Canadian dollar
- JPY Japanese yen

FX SWAPS

• A swap is an agreement to provide a counterparty with something that it wants in exchange for something that you want.

• Swap transactions (FX swaps) make up about 41 percent of $4 trn interbank FX trading, whereas outright forwards account for just 12 percent.

- FX swaps vs. Currency Swaps
- Spot sale/Fwd purchase (or vice-versa) vs. Interest-rate & currency swap
Forward Premium

"Swap rate" = forward - spot
- Yields a percentage forward premium or discount
- This premium is related to the interest rate differential

For example, suppose the € is trading spot at $S(€) = .5235 and forward at $F_{180}(€) = .5307

The annual percentage forward premium is given by:

\[ f_{180} = \frac{F_{180}(€) - S(€)}{S(€)} \times \frac{360}{180} = \frac{.5307 - .5235}{.5235} = .01375 \%

Outright forward vs. “swap rate”

- Swap rate & B-A spread
  - observation
    - subtract swap if discount, add if premium
    - why? (size of B-A spread)
  - explanations
    - risk?
    - liquidity (market depth)?
    - others?

Outright forward vs. “swap rate”

- Annualizing the forward premium/discount
  - Example: spot $1.6275 / 1€
  - 3-month outright forward $1.6230 / 1€
  - Swap rate
    - \[ f_s = -0.0045 \] / 1€ or discount of 45 “points”
  - Percentage premium/discount
    - \[ (f_s)/s = -0.0045/1.6275 \] or -0.28%
  - Annualized percentage premium/discount
    - \[ (f_s/s)^2 = -0.1111 \] or -1.11%

Summary

- Spot rate quotations
  - Direct and indirect quotes
  - Bid and ask prices
- Cross Rates
  - Triangular arbitrage
- Forward Rate Quotations
  - Forward premium (discount)
  - Forward points

Practice Problem

The current spot exchange rate is $1.55/€ and the three-month forward rate is $1.50/€. Based on your analysis of the exchange rate, you are confident that the spot exchange rate will be $1.52/€ in three months. Assume that you would like to buy or sell £1,000,000.

a. How can you speculate in the forward market?
   What is the expected dollar profit from speculation?

b. What would be your speculative profit in dollar terms if the spot exchange rate actually turns out to be $1.46/€?

c. Graph your results.
a. If you believe the spot exchange rate will be $\$1.52/\text{£}$ in three months, you should buy £1,000,000 forward for $\$1.50/\text{£}$. Your expected profit will be:

\[ \$20,000 = £1,000,000 \times (\$1.52 - \$1.50) \]

*Question:* discuss shorting the pound at 1.55 as an alternative?

b. If the spot exchange rate actually turns out to be $\$1.46/\text{£}$ in three months, your loss from the long position will be:

\[ -\$40,000 = £1,000,000 \times (\$1.46 - \$1.50) \]