The Market for Foreign Currency

UNIT 1

What you will learn:

• How to read foreign exchange quotations
• What holds currency rates together
• How banks and brokers make income in foreign exchange markets
• How money markets and exchange markets are tied together

Introduction

• In order to conduct business, Multinational Corporations (MNCs) need to be able to convert one currency into another.
• In effect, trading foreign currency amounts to changing ownership of bank accounts denominated in different currencies.
• Banks and traders are connected electronically - they trade around the clock (no actual trading place, like the stock market).
• The foreign exchange market is the biggest market in the world – $1.9 Trillion trading volume per day.
• Top 20 banks in the world conduct half of this volume.
  – Assuming a 0.03% “fee” these banks have average earnings of $7 billion annually.

• Large banks do large transactions.
• Banks usually don’t want net currencies balance - a lot can happen overnight.
• In effect, the foreign exchange currency market is a giant market, where a homogenous commodity is traded and each trader/trade is small relative to the whole market. The consequence is that virtually everyone in the exchange market is a price taker.

To buy and sell foreign currency, you need to know how the prices are quoted.
• There are two quoting conventions:
  • Direct vs. indirect quotations
    – Direct Quote: Price of a single unit of foreign currency in terms of dollars. Ex. 1.4150 $/€
    – Indirect Quote: Price of dollars in terms of foreign currency Ex. 0.7067€ /$
    – Most items in daily transactions are quoted in direct quote, i.e., $3.20 /gallon of gas

• Note the indirect quote is just the reciprocal of the direct quote.
• To avoid confusion, in this class we will:
  – use the direct quote
  – treat the foreign currency as the commodity we are buying and selling.
    • Rather than say we sold $1.41 to buy 1 €, we will say we bought 1€ for $1.40
Recall how these markets work
- An individual wants to sell 1 million € for $. 
- She contacts a currency broker and places the order to sell 1 million € for $. 
- The currency broker quotes an exchange rate (say 1.400 $/€). 
- The client accepts the order and gets $1.4 million in exchange for 1 million €. 
- If the broker is a US broker, it does not want net € balances so it quickly tries to sell the €s for dollars.

The broker specializes in € ↔ $ exchanges, so it monitors the market and sets the exchange rate so that there is a balanced amount of buy € and sell € orders.
- Other brokers might specialize in £ ↔ $ or ¥ ↔ $ trades.
- Currencies such as the €, £ or ¥ will be widely traded and it would pay to have specialist in these currencies.

What about trade in lesser currencies?
- It would not pay to have a separate broker that specializes in every different possible combination of currencies. For example, Kenyan Shilling (KES) ↔ Argentine Peso (ARS).
- With 50 currencies we would need 1,225 different specialist, some of whom would be making many trade, some barely any trades.
- To circumvent this problem we use a numeraire currency.

The numeraire currency is the currency against which we price all other currencies.
- In practice the $ is the numeraire currency.
- Therefore we would say
  0.01493 $/KES
  0.31964 $/ARS
- Then if we want to trade KES ↔ ARS we use the Cross Rate

The cross rate is simply the exchange rate between two currencies, that does NOT involve the numeraire currency.
- 21.3663 KES/ARS is an example of a cross rate.
- Where does the cross rate come from?
  - The cross rate is implied by the two rates quoted against the numeraire currency. In the above example
    \[
    \frac{0.31964/ARS}{0.01493/KES} = 21.3663 \text{ KES/ARS}
    \]

Calculate the implied cross rates
- 1.4100 $/€ and 1.8500 $/£ \(\rightarrow\) £/€
  - Cross rate 0.7622 £/€
- 1.3800 $/€ and 1.8800 $/£ \(\rightarrow\) €/£
  - Cross rate 1.3623 €/£
- Be careful of the units. In the first example, it’s Pound per Euros, while in the second it’s Euros per Pound.
• Since each exchange rate is just what the broker quotes, what makes the quoted cross rate equal the cross rate implied by the two individual rates?
  
  Answer: Triangular Arbitrage
  
  – Triangular Arbitrage is the process of exploiting deviations in the relative pricing of three currencies.

• Arbitrage is a process where trades are made which
  
  – Involve no risk
  
  – Use none of your own funds
  
  – Result in a profit

• With triangular arbitrage, we trade currency in three markets to yield a riskless profit

• EXAMPLE 1
  
  – In New York 0.8950 $/€ (market rate)
  
  – In Tokyo 1.4388 $/£ (market rate)
  
  – In London 0.6200 £/€ (market rate)

  • By "market rate, I mean that there is a broker that will trade at that exchange rate
  
  • Is there an arbitrage opportunity?
  
  • Calculate the "no arbitrage" cross rate.

  \[
  \frac{0.8950}{1.4388} = \frac{0.6220}{?/£}
  \]

  • Compare the “no arbitrage” cross rate to the market cross rate. If they are not the same then there is an arbitrage opportunity.

  – Market 0.6200 £/€ < 0.6220 £/€ No Arbitrage
  
  – € are cheap in London. They should cost 0.6220 £, but they actually only cost 0.6200 £.
  
  – You want to BUY € in London with £.
  
  – You first have to go get the £ and they are traded for $ in Tokyo.

• Arbitrage Trades

  Place an order to buy 0.6950 £ in Tokyo for $1
  
  in two days credit 0.6950 £
  
  debit $1

  Place an order to buy 1.1210 € in London with 0.6950 £
  
  in two days credit 1.1210 £
  
  debit 0.6950 £

  Place an order to sell 1.1210 € in New York for $1.0033
  
  in two days credit $1.0033
  
  debit 1.1210 £

  -->Profit $0.0033

• All the orders are place simultaneously so the successive credits pay for the debits and you are left with $0.0033 of pure profit in your account.

• Pure Profit = you neither bore risk, nor delayed consumption.

• The arbitrage is a zero sum game = what you gain is someone else’s loss
• Market adjustments after the arbitrage
  – In New York 0.8950 $/€ (market rate)
  – In Tokyo 1.4388 $/£ (market rate)
  – In London 0.6200 £/€ (market rate)

• Prices (exchange rates) change due to order flow imbalances.
  – The trader in NY is going to be getting mostly orders to SELL euros. If everyone wants to sell to you, your price is too high. The trader in NY would lower her exchange rate.
  – The trader in Tokyo is going to be getting mostly orders to BUY pounds. If everyone wants to buy from you, your price is too low. The trader in Tokyo would raise his exchange rate.
  – The trader in London is going to be getting mostly orders to BUY euros. If everyone wants to buy from you, your price is too low. The trader in London would raise his exchange rate.

• EXAMPLE 2
  – In New York 1.4100 $/€ (market rate)
  – In Tokyo 1.8500 $/£ (market rate)
  – In London 0.7700 £/€ (market rate)

  • Calculate the no arbitrage cross rate
  \[
  \frac{1.4100}{1.8500} = 0.7622 \frac{£}{€}
  \]

  • Compare to Market cross rate
  – Euros are expensive in London because they cost 0.7700 £/€ and should only cost 0.7622 £/€.
  – You want to Sell euros in London for pounds, but have to go get the euros first in NY.

• Your arbitrage profit is $0.0103 per dollar traded
• Market adjustments after the arbitrage
  – In New York 1.4100 $/€ (market rate)
  – In Tokyo 1.8500 $/£ (market rate)
  – In London 0.7700 £/€ (market rate)

  • Prices (exchange rates) change due to order flow imbalances.
  – The trader in NY is going to be getting mostly orders to BUY euros. If everyone wants to buy from you, your price is too high. The trader in NY would raise her exchange rate.
  – The trader in London is going to be getting mostly orders to SELL euros. If everyone wants to sell to you, your price is too high. The trader in London would lower his exchange rate.
  – The trader in Tokyo is going to be getting mostly orders to SELL pounds. If everyone wants to sell to you, your price is too high. The trader in Tokyo would lower his exchange rate.

• The exchange rates would adjust until the market cross rate equaled the implied (no arbitrage) cross rate.
• The act of arbitrage trading keeps the cross rates appropriate.

Two ways banks make money:

• (1) transfer fee
  – The transfer fee is the charge for wiring the funds from one bank to another. As a percentage of the transaction, this fee is negligible.

• (2) foreign exchange fee
  – Foreign Exchange fee is done through a Bid-Ask Spread.
  – Bid Price - Price at which banks will buy a currency
  – Ask Price - Price at which banks will sell a currency
If you had 1 € how many dollars could you get? Ans. $1.4100
If you had $1.00 how many € could you get? Ans. 0.7075 €
If you had 1.0000 £ how many € could you get? Ans. 1.3017 €
If you had 1.0000 € how many £ could you get? Ans. 0.7404 £

• Convertibility
  – Some currencies cannot be converted - for example, it's very difficult to exchange Russian Ruble
• "Round trip" – The amount you would lose by buying then selling back the currency
• Banks have little control over the prices they charge.
  – Foreign exchange rates quoted cannot differ too much between banks - why?
  – The Process of Arbitrage equalizes the exchange rates everywhere

• Determinants of spread
  – Frequency of trading
    • The less frequently a currency trades the larger the bid-ask spread
  – Volatility of Exchange Rate
    • The more volatile a currency the larger the bid-ask spread

• In the above example it's more expensive to trade € than £.

• Example

• Simultaneously buy € from Bank 1 at $0.5626 and sell to Bank 2 at $0.5627 ---- yield $0.001 riskless profit
• Broker at Bank 1 would receive mostly BUY orders and realize it must raise its price
• Broker at Bank 2 would receive mostly SELL orders and realize it must lower its price

Forward Market

• A Forward contract is a contract between 2 parties (usually one is a bank/broker) where the two parties agree to exchange a predetermined amount of currency at a predetermined rate at some known future date
• The contract is specified by 4 terms:
  – Buy or Sell Currency
  – Amount of currency
  – Delivery Date
  – Forward Exchange rate
• *Must fulfill the contract

Example Rates

• Normally, there is a bid price and an ask price for the spot AND forward rates

  * Today, you could exchange $100,000 for 111,732 €
  * You could contract today such that in 180 Days you could exchange $100,000 for 110,865 €
Forward Discount or Premium

- In the above example, € for future delivery are more expensive than € for current delivery.
- We say 180 Day Forward rate is at a forward premium.
- The formula for the forward discount or premium is given as

\[ \% \text{ Discount or Premium} = \frac{\text{Forward} - \text{Spot}}{\text{Spot}} \times \frac{360}{N} \times 100\% \]

• In our example:

\[ \frac{0.9020 - 0.8950}{0.8950} \times \frac{360}{180} \times 100\% = 1.5642\% \]

- The 180 day forward euro is at a premium
- To what are Discount/Premiums related?
- Interest rates - differences in two countries

Covered Interest Rate Parity (CIP)

- Principle: The same currency denomination rate of return on default free financial instruments will be the same everywhere.
- Covered interest parity means there is no risk because all future transactions are covered by forward contracts.
- Certain Dollar rate of return must be the same in all countries. This should hold or you would have arbitrage.

Derivation of CIP

- Notation

\[ i_{US} = \text{US interest rate} \]
\[ i_f = \text{Foreign interest rate} \]
\[ e_0 = \text{spot rate direct quote} \]
\[ f_{t} = \text{forward rate} \]

- Note the forward rate horizon matches the interest rate investment horizon

\[ \frac{f_{t}}{e_0} = \frac{(1 + i_{US})}{(1 + i_f)} \]

CIP

If we do a little algebra with this we get

\[ \frac{\text{Forward Premium/Discount}}{\text{Spot}} = \frac{(1 + i_{US})}{(1 + i_f)} - 1 \]

If \( i_f \) is small then

\[ D \approx i_{US} - i_f \]

Approximate Formula
• The calculations from the previous page tell us that the forward discount or premium is related to the interest differences between the two countries
• The forward discount premium is approximately the difference in the interest rates

Exact Forward Premium

\[
\frac{1.4515 \frac{\$}{\text{€}} - 1.4100 \frac{\$}{\text{€}}}{1.4100 \frac{\$}{\text{€}}} \times 100\% = 2.9433\%
\]

Approximate Forward Premium

\[D \approx \Delta_{US} - \Delta_f = 5\% - 2\% = 3\%
\]

What Makes CIP Hold?

• The act of arbitrage makes CIP hold

Example

<table>
<thead>
<tr>
<th>interest rates</th>
<th>US</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>i_{US}</td>
<td>8%</td>
<td>i_f = 10%</td>
</tr>
<tr>
<td>e_0</td>
<td>0.8500</td>
<td>\text{€}</td>
</tr>
<tr>
<td>0f_1</td>
<td>0.8245</td>
<td>\text{€}</td>
</tr>
</tbody>
</table>

Is there an arbitrage opportunity?

According to CIP \[
\frac{(1+i_{US})}{(1+i_f)} \times e_0 = 0f_1
\]

\[
\frac{1.08}{1.10} \times 0.8500 = 0.8345 \frac{\text{€}}{\text{£}}
\]

or there is an arbitrage opportunity

Alternatively

Certain $ rate of return in US

\[
$1(1 + 0.08) = $1.08
\]

Certain $ rate of return in Germany

\[
\frac{$1(1 + 0.08)}{0.8500} \times 0.8345 \frac{\text{€}}{\text{£}} = $1.0670
\]

Today

1. Borrow \[\frac{1.1765 \text{€}}{1.3000 \frac{\text{€}}{\text{£}}}\] in Germany at 10% for 1 year
2. Convert 1.1765€ into $ which gives you $1 at spot rate 0.8500 \[\frac{\text{£}}{\text{€}}\]
3. Invest $1 in US at 8% for 1 year
4. Contract to Buy 1.2941€ = (1.1765€)*(1.10) in one year at 0.8245 \[\frac{\text{€}}{\text{£}}\] forward rate.

In one year

1. Collect $1.08 from US investment
2. Fulfill contract --> spend $1.067 get 1.2941€
3. Arbitrage profit $0.01301 per $1
With the information below:

\[ e_0 = 1.4100 \quad S/€ \]
\[ f_0 = 1.4400 \quad S/€ \]

US interest rate = 0.0700
Foreign interest rate = 0.0400

(i) Show whether there is an arbitrage opportunity

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<tr>
<td>Action</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Invest</td>
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<tr>
<td>Borrow</td>
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<tr>
<td>Convert to</td>
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<tr>
<td>dollars</td>
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$\text{Profit} = e_0 - f_0 = 1.4100 - 1.4400 = -0.0300$