FOREIGN EXCHANGE MARKETS
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Foreign Exchange Markets

AGENDA

- Basic characteristics of FX markets:
  - Institutional features
  - Spot markets
  - Forward markets
- Appreciation, depreciation, premium, discount

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AGENDA (cont)

- Purchasing power parity; real exchange rates
- Covered interest parity; speculative efficiency
- Nature of exchange rate exposure of MNEs
- What determines the value of exchange rates in the medium term?

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Foreign Exchange Markets: Key Institutional Features

- Largest market in the world;
- OTC, mostly interbank; almost 24 hours;
- Both market makers and brokers;

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Foreign Exchange Markets: Key Institutional Features (cont)

- 85% of trades are based on “direct deals” between market makers;
- 90% of trades take place with respect to US$ (reduces information complexity and absence of triangular arbitrage);

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Foreign Exchange Markets: Key Institutional Features (cont)

- Euro (€), UK£, Aus$, and NZ$ quoted direct (“American”) and the rest indirect;
- When you buy and sell FX, it basically involves deposit transfers at the end of the day;
- SWIFT and CHIPS for clearing;

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Foreign Exchange Markets: Key Institutional Features (cont)

- Three types of exchange rates to think about: 'spot' exchange rates (e_0), 'forward' exchange rates (e_t), and 'expected future spot' exchange rates ($E[e^t_0]$).

Foreign Exchange Markets: Key Institutional Features (cont)

- The first two, e_0 and e_t, are known (or knowable with reasonable certainty), while the third, $E[e^t_0]$, is an unknown variable and has to be forecasted.

Foreign Exchange Markets: Key Institutional Features (cont)

- Spot transactions:
  - Agreement on price today with settlement two business days hence. (Notation: e_0 or sometimes just e)
- Outright Forward transactions:
  - Agreement on price today for settlement at future date, usually, 30, 90, 180 days (Notation: e_t, where t = 30, 90, etc).

Foreign Exchange Markets: Key Institutional Features (cont)

- Swap transactions:
  - Agreement to buy or sell in the spot market with simultaneous agreement to reverse the trade in forward markets.
  - Most forward contracts are quoted as 'swap' quotes.
- 65% of trades are in spot, 33% in 'swap', and 2% in 'outright' forwards.

Appreciation, Depreciation, Premium, Discount

- Using the direct quote (i.e., $/FX), when:
  - e increases, FX appreciation
  - e decreases, FX depreciation
  - For example, if the $/£ exchange rate today is $1.52/£, and two months ago, it was $1.55/£, then, during the past two months, e has decreased, and the UK£ has depreciated by ¢3 against the US$

Appreciation, Depreciation, Premium, Discount (cont)

- Using the direct quote, when the forward rate is larger than the spot rate, the foreign currency is at a forward premium.
- For example, if the 90-day forward rate, e_{90}, on the UK£ is $1.53/£ (which is higher than the spot rate e_0), then the £ is at a forward premium.

Appreciation, Depreciation, Premium, Discount (cont)

- Similarly, when the forward rate is lower than the spot rate, the foreign currency is at a forward discount.
- The reverse is true in the case of an indirect quote.

From the US perspective, what are the direct and indirect quotes?

October 5, 2000

Currency	Close	Bid-Ask	1 month	3 months	1 year
SFr	1.7329	325-333	1.7279	1.7189	1.6823
£ (UK)	0.6860	858-861	0.6856	0.6848	0.6827
US$	0.8764	762-765	0.8778	0.8803	0.8902
N$(MX)	9.4055	040-070	9.4995	9.6680	10.3735

Direct Quote: $0.8764/€
Indirect Quote: €1.1410/$

Bid-Ask Spreads

- Bid-ask spreads reflect prices at which the FX market will buy from you and sell to you.
- For example, consider a quote of $0.8762/0.8765€ : the smaller number is the bid, and the larger the ask. In this case, the bid and ask are for €.

Bid-Ask Spreads (cont)

- That is, if you want to sell €, the market will "bid" you (i.e., buy from you) an exchange rate of $0.8762 per €. If you want to buy €, the market will "offer" you (i.e., ask from you) a higher exchange rate of $0.8765 per €.

Bid-Ask Spreads (cont)

October 5, 2000

Currency	Close	Bid-Ask	1 month	3 months	1 year
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Bid Quote: $0.8762/€
Ask Quote: $0.8765/€

From the US perspective, what are the 30-, 90-day and 1-year forward rates on the Euro?

October 5, 2000

Currency	Close	Bid-Ask	1 month	3 months	1 year
SFr	1.7329	325-333	1.7279	1.7189	1.6823
£ (UK)	0.6860	858-861	0.6856	0.6848	0.6827
US$	0.8764	762-765	0.8778	0.8803	0.8902
N$(MX)	9.4055	040-070	9.4995	9.6680	10.3735

Direct Quotes: $0.8778/€, $0.8803/€, $0.8902/€

Exercises (cont)

- The forward rates are higher than the spot rate (i.e., $e_t > e_0$).
  - Thus, the € is trading at a *forward premium relative to the US$.*
- Premium (90 day) = 0.8803/0.8764 – 1 = 0.445%
- Premium (annualized)
  = 0.445% * 360/90 = 1.78%

Exercises (cont)

- The € was at $1.05/€ exactly one year prior. Compared to the exchange rate of October 5, 2000, did the Euro appreciate or depreciate? By what percentage?
- The Euro depreciated.
- It depreciated by 16.53%, since
  $[e_1/e_0] – 1 = [0.8764/1.05] – 1$
  = –16.53%

Exercises (cont)

- We will use the notation 'Δe' to describe the 'expected percentage change in the value of the foreign currency'.
- In this case, Δe = –16.53% (Note that the negative sign implies a foreign currency *depreciation* relative to the home currency).

Exercises (cont)

- Suppose you sell goods worth US$1.5 million, payable in €, in the European Union (EU). The buyer will pay for the purchase in 90 days. What will be your proceeds if the € trades at US$0.91 three months from now (i.e., the € appreciates)?

Exercises (cont)

- Invoice amount:
  US$1,500,000/US$0.8764/€ =
  €1,711,547
- Payment 90 days from now:
  €1,711,547 * US$0.91/€ =
  US$1,557,507.8

Exercises (cont)

- What will be your proceeds if the € trades at US$0.85 three months from now (i.e., the € depreciates)?
- Invoice amount:
  US$1,500,000/US$0.8764/€ =
  €1,711,547
- Payment 90 days from now:
  €1,711,547 * US$0.85/€ =
  US$1,454,815

Exercises (cont)

- You get a lower-than-anticipated amount if you are an exporter and the foreign currency depreciates (i.e., $\Delta e < 0$).

Exercises (cont)

- Is there a way to get rid of uncertainty?
- Is it possible to *hedge* receivables?
  - Sell expected € receipts forward

Exercises (cont)

- Invoice amount: €1,711,547
- Sell this forward at the 90-day forward rate of \$0.8803/€
- €1,711,547 * US\$0.8803/€
  = US\$1,506,674.8
- Note that this is guaranteed

Equilibrium Theories in Int'l Finance and Their Implications

- Four theories of equilibrium underlie most applications of international finance:
  - Purchasing power parity (PPP)
  - Covered interest parity (CIP)
  - The speculative efficiency hypothesis (SEH)
  - Uncovered interest parity (UIP)

Equilibrium Theories in Int'l Finance and Their Implications (cont)

- The four theories link three sets of variables: exchange rates, prices, and interest rates.

Purchasing Power Parity
(Link Between Exchange Rates and Prices)

- There is an equilibrium relation between the domestic price level (P), the foreign price level (P*), and the exchange rate (e, direct quote), between the domestic and the foreign country:

$$P = eP^*$$

Purchasing Power Parity (cont)

- For example, if one pound of wheat costs FF5 in France, and the $/FF exchange rate is $0.20/FF, then PPP says that a similar pound of wheat should cost $1 in the US. If not, there would be an arbitrage opportunity. (WHY?)

Purchasing Power Parity (cont)

- Another way of expressing this is in relative, rather than absolute, terms.
- This way of expressing it is called RPPP:

$$1 + \Delta P = (1+ \Delta e)(1 + \Delta P^*), \text{ or}$$

$$\Delta e = [(1 + \Delta P)/(1 + \Delta P^*)] - 1$$

where, ΔP is the expected percentage change in the domestic price level, and ΔP^* is the expected change in the foreign price level.

Purchasing Power Parity (cont)

- RPPP says that expected % change in value of the FX equals one plus the expected domestic rate divided by one plus the expected foreign inflation rate, minus one.
- For example, if the expected inflation rate in the US is 3% and Japan 1%, RPPP says that the ¥ would be expected to appreciate by (1.03/1.01) – 1 ≈ 2% against the US$.

Purchasing Power Parity (cont)

- Why does PPP matter?
- It helps define the concepts of *real* appreciation and real depreciation. These are exchange rate changes over and above (or under and below) that which would be predicted by RPPP

Purchasing Power Parity (cont)

- Such real changes lead to changes in the competitive position of a firm with respect to its foreign competitors.
- This, in turn, creates the problem of "economic exposure to exchange rates", as we'll later see.

Exercises

- The inflation rate during the past year in the US was 2% and the average inflation rate for the €-zone was 4%. Would the theory of RPPP have predicted a Euro appreciation or depreciation during that time?

Exercises (cont)

- Inflation in the US was 2% *lower* than in the €-Zone.
- RPPP would have predicted a (1.02/1.04) – 1 = – 0.0192, or a 1.92% *depreciation* of the Euro.

Exercises (cont)

- But, recall that the Euro depreciated by 16.52% in 'nominal' or 'actual' terms.
- RPPP says it should have depreciated by only 1.92%. In other words, the Euro depreciated by 16.63% – 1.92% = 14.61% *more* than predicted by RPPP.

Exercises (cont)

- The Euro depreciated 14.61% in real terms.
- Real exchange rate change =
  Actual change minus
  RPPP-predicted change.

Covered Interest Parity
(Link Btw Exchange Rates and Interest Rates)

- CIP establishes an equilibrium *no-arbitrage* relation between domestic and foreign nominal interest rates (r, and r*), and spot and forward exchange rates (e_0, and e_t):

$$e_t / e_0 = (1+r)/(1+r^*)$$

Covered Interest Parity (cont)

- It can also be stated in an 'approximate' form as follows:

$$\% \text{ Forward Premium} = (e_t - e_0)/e_0 \approx r - r^*$$

- Note: Always use the exact form.

Covered Interest Parity (cont)

- For example, if US nominal interest rates are higher than Japanese, CIP says that \$/¥ forward will be higher than \$/¥ spot: i.e., the Japanese ¥ will be at a forward premium.

Covered Interest Parity (cont)

- How well does CIP hold up in the real world? Extremely well (with eurocurrency interest rates)! In fact, this is how banks determine forward exchange rates.

Exercises

- Consider the one-year forward rate quote and the appropriate € and US$ interest rates. Does the covered interest parity (CIP) hold?
  - One year forward rate: US$0.8902/€
  - Spot Rate: US$0.8764/€
  - One-year $-Libor Rate: $6\ ^3/_4$ %
  - One-year Euribor Rate: $5\ ^3/_{32}$ %

Exercises (cont)

- $(1 + r_d)/(1 + r_f) = 1.016$
- $e_t/e_0 = 1.016$
- CIP holds very well.

Problem 3

- $e_0 = 0.90$; r = 7%; r* = 5% (annualized)
- 90-day interest rates are 1.75% and 1.25%, respectively
- Want the 90-day forward rate e_t …..
- The forward rate will be equal to:

  $e_t = e_0*(1.0175/1.0125)$ =US$0.9044/€

Exercises (cont)

- Suppose the following market conditions:
  - Spot = $1.09/€
  - 1-year Forward = $1.14/€
  - € Interest Rate = 3% p. a.
  - US$ Interest Rate = 6% p. a.
  - No transaction costs and taxes
- Do covered interest arbitrage profits exist in the above situation?

Exercises (cont)

- Arbitrage profits do exist.
- $(1 + r_d)/(1 + r_f) = 1.06/1.03 = 1.0291$
- $e_t/e_0 = 1.14 / 1.09 = 1.0459$
- Interest rates are too low in the US and/or too high in €-land.
- Want to borrow where interest rates are 'low' and invest where interest rates are 'high.'

Exercises (cont)

- Thus,
  - *Borrow* money in the US $1,000 at 6%
  - *Convert* into € at spot (e) €917.43
  - *Invest* in €-land at 3% €944.95
  - *Sell € Forward* at e_t $1,077.25
  - *Repay* Loan $1,060
  - The arbitrage profit is $1077.25 – $1060.00 = $17.25.

Speculative Efficiency (Link Btw Forward & Expected Future Spot Rate)

- Speculative efficiency (SEH) says that the best unbiased predictor of the expected future spot rate is the observed forward rate.
- For example, if we observe that the 90-day ¥/$ forward rate is ¥95/$. SEH tells us that this is the market's best guess of where it thinks the actual $/¥ exchange rate will be, 90 days from now. Why?

Speculative Efficiency (cont)

- Suppose the speculator's expected future spot ¥/$ rate is 93.
- What would (s)he do?

Speculative Efficiency (cont)

- The speculator would start to purchase ¥ for US$ in the forward market at 95. Say, she agrees to buy $100 worth of forward yen. She is guaranteed to receive ¥9500 by giving up $100, ninety days from now.

Speculative Efficiency (cont)

- Suppose her prediction of ¥93/$ turns out true. She can turn around and sell the ¥9500 to get 9500/93 = US$102.15.
- She thus makes a speculative profit of $2.15 for every $100 she bets.

Speculative Efficiency (cont)

- Of course, she would want to do more of this, or others in the market may start to do the same thing. There will be increased demand for "forward ¥".
- As a result, the forward rate would appreciate until expected future spot rate and forward rate are equal.

Speculative Efficiency (cont)

- Likewise, if the foreign currency is more expensive compared to the expected future spot rate, investors would start selling it forward. The forward rate would then depreciate until an equilibrium is reached. Convince yourself by constructing an example!

Uncovered Interest Parity
(Another Link Between Exchange Rates & Interest Rates)

- Thus, if, both CIP and SEH hold true, they must together imply that

$$e_t = E(e_0^t),$$

- Thus,

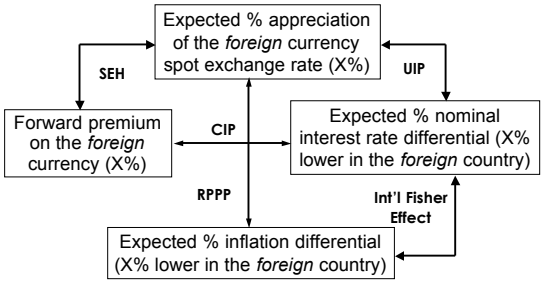
$$[E(e_0^t)/e_0] = [(1+r)/(1+r^*)] \quad \text{(EXACT FORM)}$$

or,
$$\Delta e \approx r - r^* \quad \text{(APPROX FORM)}$$

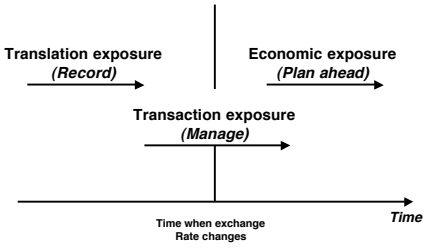
Uncovered Interest Parity
(cont)

- Again, always use the exact form in calculations.
- How well does UIP hold up in the real world? Poorly!

Summary: The Four Key Relations (Plus One!) (in approximated form)



Types of Exchange Rate Exposure



Economic/Competitive Exposure: Example

- Suppose you are a US firm competing against a Japanese firm in Japan. You sell your products in Japan in ¥, your costs are all incurred in US$, and you repatriate your revenues and profits back home.
- The initial exchange rate is US$1 = ¥100

Economic/Competitive Exposure: Example (cont)

- Assume that your price-per-unit and average costs are the same as that of your Japanese competitor (i.e., you both are equally competitive), and you both sell the same number of units (i.e., you have the same market share).

Economic/Competitive Exposure: Example (cont)

- Say, your initial revenues are $2, your costs are $1.60. Thus your profit margin is 20%.
- Say, your Japanese competitor's initial revenues are ¥200, costs are ¥160, its profit margin is 20% too.
- All these are simplifying assumptions.

When PPP Holds, There is No Economic Exposure.....

	Initial Situation		10% US Inflation-PPP Holds	
	US	Japan	US	Japan
Exchange rate	*¥100/$1*		*¥90.9/$1**	
Revenues	$2.00	¥200	$2.20	¥200
Costs	$1.60	¥160	$1.76	¥160
Profit	$0.40	¥ 40	$0.44	¥ 40
Margin	20%	20%	20%	20%

**Applying the RPPP formula with Japan as the 'home' country, Δe =(100/110) – 1 = –9.1%, or a 9.1% depreciation of US$ against yen.*

Suppose...

- …the exchange rate stayed at ¥100/$1 (i.e., the US appreciated in real terms by 9.1%, instead of nominally depreciating to ¥90.9/$ to adjust for the higher US inflation):

PPP Breakdown Creates Economic Exposure.....

	Initial Situation		10% US Inflation-PPP Does Not Hold	
	US	Japan	US	Japan
Exchange rate	*¥100/$1*		*¥100/$1*	
Revenues	$2.00	¥200	$2.00	¥200
Costs	$1.60	¥160	$1.76	¥160
Profit	$0.40	¥ 40	$0.24	¥ 40
Margin	20%	20%	12%	20%

What determines the value of exchange rates (medium term)?

- The value of a currency is similar to that of any asset: it is the discounted sum of the expected cash flows resulting from expectations of future evolution of fundamentals.

What determines the value of exchange rates? (cont)

- What are these fundamentals? There is general agreement that the following matter, in the medium term:
  - National income (Y)
  - Exports (X), and imports (M)
  - Money supply (M^s);Money demand (M^d)
  - Real interest rates (r^r)
  - Nominal interest rates (r^n)
  - Inflation expectations (ΔP)

What determines the value of exchange rates? (cont)

- Assuming the direct quote, *e* is expected to increase (i.e., HC depreciate) if:
  - National income decreases
  - Current account balance worsens
  - Money supply increases or money demand decreases
  - Real interest rates decrease or nominal rates increase
  - Inflation rates increase

What determines the value of exchange rates? (cont)

- In the short term, currency values are driven, rightly or wrongly, by *technical* considerations related to currency trading.
- Three additional points:
  - Expectations of (rather than actual) changes in fundamentals are sufficient;
  - Levels are less important than changes in levels; and
  - All expected changes in levels are relative to expected changes in the foreign country.