CHARTA LEARNING · LESSON NOTES

Foreign Exchange Markets

FRM Part I

1 A story: the airport booth

- Two prices: the booth buys low and sells high
- The gap between them pays the dealer
- Rates for today and for later differ
- Behind the booth: dealers, hedgers, arbitrageurs

IN THE LESSON

- Picture the currency booth at an airport.
- A sign shows two numbers for euros.
- One is what the booth pays you for euros, and the other is what it charges you for euros.
- The charge is always higher.
- If you buy euros and sell them straight back, you lose money to the booth, and that gap is how the booth earns a living.
- The same booth also posts a rate for delivery next month, which differs from today's.
- Behind that humble sign sit the biggest markets in the world: dealers quoting two way prices, companies hedging bills, and arbitrageurs keeping spot, forward and interest rates in line.
- This lesson explains each of those pieces.

2 How a quote is read

- EUR/USD 1.0840 / 1.0844: base EUR, quote USD
- Dealer buys base at the bid, sells base at the ask
- Client buying the base pays the ask
- Client selling the base receives the bid
- Direct = home per foreign; indirect = its reciprocal

IN THE LESSON

- A currency quote gives the price of one currency, called the base, in units of another, called the quote currency.
- Take euro dollar, one point zero eight four zero over one point zero eight four four.
- The base is the euro and the quote currency is the dollar.
- The dealer buys one euro for one point zero eight four zero, the bid, and sells one euro for one point zero eight four four, the ask.
- The golden rule is to read the quote from the dealer's side.
- A client who buys the base currency pays the ask.
- A client who sells the base currency receives the bid.
- A direct quote is the home currency per unit of foreign currency, and the indirect quote is its reciprocal.

3 Example 1: buying and selling euros

Illustration: EUR/USD 1.0840 / 1.0844, deal size EUR 1 million

Client buys EUR: pays ask	1,000,000 × 1.0844	**$1,084,400**
Client sells EUR: gets bid	1,000,000 × 1.0840	**$1,084,000**
Round trip	buy at ask, sell at bid	**−$400**

IN THE LESSON

- Here is an illustration with euro dollar at one point zero eight four zero over one point zero eight four four.
- A client wants to buy one million euros.
- The client buys the base, so the dealer sells and the client pays the ask.
- One million times one point zero eight four four is one million, eighty four thousand, four hundred dollars.
- Now the client sells one million euros instead.
- The dealer buys, so the client gets the bid.
- One million times one point zero eight four zero is one million, eighty four thousand dollars.
- Do the round trip, buying and selling straight back, and the client is out four hundred dollars.
- That four hundred dollars is the dealer's spread on a million euros.

4 Example 2: inverting a two-way quote

Illustration: invert EUR/USD 1.0840 / 1.0844 into USD/EUR

New bid	1 ÷ old ask (1.0844)	**0.9222**
New ask	1 ÷ old bid (1.0840)	**0.9225**
Result: USD/EUR	bid / ask	**0.9222/0.9225**

IN THE LESSON

- Now we turn the same quote around, to dollars per euro becoming euros per dollar.
- Inverting takes the reciprocal, but the sides swap.
- The new bid is one divided by the old ask.
- One divided by one point zero eight four four is point nine two two two.
- The new ask is one divided by the old bid.
- One divided by one point zero eight four zero is point nine two two five.
- So the dollar euro quote reads point nine two two two over point nine two two five.
- Check the logic.
- A dealer who buys dollars gives away euros, and the old ask is the largest number of dollars per euro, so it gives the fewest euros per dollar.
- Inverting without swapping the sides is the usual mistake.

5 Spot, forward and futures quotes

- Spot: two-way quote, delivery in two business days
- Forward: spot plus points (separate bid and ask)
- Forward = over the counter, any date and size
- Futures: exchange, one price, standard size and date

IN THE LESSON

- The same pair is quoted in three markets.
- In the spot market the quote is for delivery in two business days.
- In the forward market the dealer quotes the spot rate plus forward points, with separate points for the bid and the ask.
- The points can be positive or negative, and they reflect the difference between the two interest rates.
- A forward is a private contract, traded over the counter, with whatever date and size the client needs.
- A futures contract is different.
- It trades on an exchange, with one quoted price rather than a two way quote, a standard contract size and a standard delivery date.
- Forwards are tailor made and futures are standardized.

6 The spread, the mid rate, and the percentage

Spread = Ask − Bid (1 pip = 0.0001)
Mid = (Bid + Ask) ÷ 2
% spread = Spread ÷ Mid

Ask	Price the dealer sells at
Bid	Price the dealer buys at
Spread	Ask minus bid, in pips
Mid rate	Halfway between bid and ask

IN THE LESSON

- Now the spread.
- The bid ask spread is the ask minus the bid.
- For most currency pairs it is quoted in pips, where one pip is point zero zero zero one.
- The mid rate is the bid plus the ask divided by two, the halfway point.
- To compare spreads across pairs or across maturities, express the spread as a percentage of the mid rate.
- The dealer earns the spread for three things: the cost of processing orders, the risk of holding inventory whose price may move, and the risk of trading against clients who know more.
- So the spread widens when volatility rises or liquidity falls.
- Always compare spreads in the same units.

7 Example 3: spot spread and forward spread

Illustration: spot 1.0840 / 1.0844. 3-month points +52 / +57

Spot spread	1.0844 − 1.0840 = 4 pips	**0.037%**
Forward bid	1.0840 + 0.0052	**1.0892**
Forward ask	1.0844 + 0.0057	**1.0901**
Forward spread	4 + (57 − 52) = 9 pips	**0.083%**

IN THE LESSON

- Take the spot quote again, one point zero eight four zero over one point zero eight four four.
- The spread is point zero zero zero four, which is four pips.
- The mid rate is one point zero eight four two, so the percentage spread is about point zero three seven per cent.
- Now the three month forward, quoted with points of fifty two on the bid and fifty seven on the ask.
- The outright forward bid is the spot bid plus fifty two pips, one point zero eight nine two.
- The outright forward ask is the spot ask plus fifty seven pips, one point zero nine zero one.
- The forward spread is nine pips, which is four plus the five pips between the points.
- As a percentage it is about point zero eight three per cent, more than double the spot.

8 Why forward spreads are wider

- Forwards are less liquid, so harder to lay off
- Longer dated: credit exposure to the client builds up
- More uncertainty about funding and hedging costs
- Forward bid = spot bid + bid points; same for ask
- Points are negative when the forward is at a discount

IN THE LESSON

- Why would the forward spread be wider than the spot spread?
- Both trade over the counter, but they differ in several ways.
- Forwards are less liquid, so a dealer cannot always lay off the position quickly.
- They are longer dated, so the dealer carries credit exposure to the client for months, not days.
- And there is more uncertainty about future funding and hedging costs.
- The mechanics also matter.
- The forward bid is the spot bid plus the bid points, and the forward ask is the spot ask plus the ask points.
- When the forward trades at a discount the points are negative.
- Expect the forward spread to exceed the spot spread, and expect both to widen in stress.

9 Swap versus outright forward

Both fix the rate today; they differ in what is left over

Feature	Outright forward | FX swap
Exchanges	One | Two, opposite
Open currency position	Yes | Largely offset
What remains	Exposed | Forward points
Typical use	Hedge one flow | Fund, roll

IN THE LESSON

- Next, two ways to deal for a future date.
- An outright forward is a single purchase or sale of currency for delivery on one future date.
- It leaves the holder with an open position in that currency.
- An F X swap is a single transaction made of two opposite exchanges of the same amount on two different dates, with both rates fixed at the start.
- The usual form buys a currency spot and sells it forward, or the reverse.
- Because the legs offset, the swap has almost no exposure to the spot rate.
- What is left is the gain or cost from the difference between the two rates, the forward points, which reflect the interest rate gap.
- Swaps fund or roll positions, and outrights hedge a single flow.

10 Example 4: a swap and its two legs

Illustration: buy EUR 1 million spot, sell EUR 1 million forward 3 months

Spot leg: buy EUR at ask	−1,000,000 × 1.0844	**−$1,084,400**
Forward leg: sell EUR at bid	+1,000,000 × 1.0892	**+$1,089,200**
Net, locked in today	52 pips of points − 4 pips	**+$4,800**

IN THE LESSON

- Let's price a swap with the same quotes.
- A client buys one million euros spot and sells them back in three months.
- On the spot leg the client buys the base, so pays the ask, one point zero eight four four, and pays one million, eighty four thousand, four hundred dollars.
- On the forward leg the client sells the base, so receives the forward bid, one point zero eight nine two, and gets one million, eighty nine thousand, two hundred dollars.
- The net is a gain of four thousand, eight hundred dollars.
- Notice the client has no exposure to where the spot rate goes.
- The four thousand, eight hundred is the fifty two pips of forward points less the four pip spot spread, because each leg used the dealer's side of the quote.
- The points compensate for the interest rate difference.

11 Three kinds of currency risk

- Transaction: contracted cash flows, ends in real cash
- Translation: restating subsidiaries, no cash moves
- Economic: lasting change hits future operating flows
- Home-currency invoicing removes transaction risk only

IN THE LESSON

- Currency risk comes in three forms.
- Transaction risk is the effect of exchange rate changes on the home value of cash flows that are already contracted, such as a receivable, a payable or a foreign currency loan.
- It ends in a real cash gain or loss.
- Translation risk is an accounting effect.
- When a parent restates a foreign subsidiary's statements into its reporting currency, the reported values change even though no cash moves.
- Economic risk, also called operating risk, is the effect of lasting exchange rate changes on the present value of future operating cash flows and competitive position, including sales not yet contracted.
- A firm that invoices everything at home can have no transaction risk and still have economic risk.

12 Comparing the three risks

Three questions separate the risks

Question	Trans. | Transl. | Econ.
Time horizon	Short | Snapshot | Long
Contracted flow?	Yes | No | No
Cash actually moves?	Yes | No | Over time
Example	Bill | Subsidiary | Rivals

IN THE LESSON

- Now compare them side by side.
- Look at three questions: the time horizon, whether the cash flow is contracted, and whether cash actually moves.
- Transaction risk is short term, contracted, and ends in cash.
- Translation risk is a snapshot at the reporting date, based on balance sheet values, and involves no cash at all.
- Economic risk is long term, applies to flows that are not yet contracted, and works through the firm's competitiveness.
- A concrete case.
- A United States exporter sells to Europe.
- A signed euro invoice is transaction risk.
- Restating its European subsidiary is translation risk.
- And a lasting fall in the euro that makes its rivals cheaper is economic risk, even if every invoice is in dollars.

13 Example 5: hedging a euro receivable

Illustration: EUR 2 million due in 3 months. USD 4%, EUR 2% a year

Forward hedge: sell at bid	2,000,000 × 1.0892	**$2,178,400**
Borrow PV in EUR	2,000,000 ÷ 1.005	**€1,990,050**
Convert at spot bid	1,990,050 × 1.0840	**$2,157,214**
Invest 3 months at USD 4%	2,157,214 × 1.01	**$2,178,786**

IN THE LESSON

- A United States firm will receive two million euros in three months.
- It is long euros, so the transaction hedge is to sell them forward.
- Spot is one point zero eight four zero over one point zero eight four four, the forward bid is one point zero eight nine two, and the dollar rate is four per cent, the euro rate two per cent.
- With the forward sale the firm locks in two million times one point zero eight nine two, which is two million, one hundred seventy eight thousand, four hundred dollars.
- The money market hedge does the same job.
- Borrow the present value, two million over one point zero zero five, about one million, nine hundred ninety thousand euros.
- Convert at the spot bid.
- That gives about two million, one hundred fifty seven thousand dollars.
- Invest it at one per cent for the quarter, and it grows to about two million, one hundred seventy nine thousand.

14 A hedge for each risk

Match the tool to the type of risk

Risk	Main hedge
Receivable / payable	Forward or money market hedge
Contingent exposure	Put or call option
Translation	Balance sheet hedge
Economic	Match costs and revenues

IN THE LESSON

- Each risk has its own hedge.
- For a receivable, sell the currency forward, or use the money market hedge we just built.
- For a payable, reverse the steps.
- If the exposure is contingent, as when a bid for a contract may be lost, use an option, a put for a receipt or a call for a payment, because a forward would leave a naked position if the deal never happens.
- Translation exposure is reduced with a balance sheet hedge, financing foreign assets with local currency liabilities, or by hedging the net investment with forwards.
- Economic risk is long term, so the answer is operational: match the currency of costs and revenues, diversify markets and suppliers, or borrow in the foreign currency.
- Short dated forwards only postpone it.

15 Example 6: a balance sheet hedge

Illustration: EUR 10m assets, equity-funded. EUR/USD 1.10 to 1.05

Net assets at 1.10	10,000,000 × 1.10	**$11.0 million**
Net assets at 1.05	10,000,000 × 1.05	**$10.5 million**
Translation loss, unhedged	10.5 − 11.0	**−$0.5 million**
Net exposure after hedge	EUR assets − EUR liabilities	**EUR 0**

IN THE LESSON

- Here is translation risk in numbers.
- A United States parent has a European subsidiary with net assets of ten million euros.
- The rate moves from one point one zero to one point zero five dollars per euro.
- At the start the net assets are worth eleven million dollars, and at the end ten and a half million.
- So the parent reports a translation loss of half a million dollars, about four and a half per cent, though no cash left the firm.
- Now apply a balance sheet hedge.
- Assume the ten million euros of assets are funded by the parent's equity.
- Replace that funding with ten million euros of local borrowing, with the proceeds returned to the parent.
- Now euro assets minus euro liabilities is zero, so net euro exposure is zero.
- The reported loss on the assets is offset by a gain on the liability.

16 Hedging several currencies with one option

- One basket option instead of one option per currency
- Imperfect correlation makes the basket less volatile
- Lower volatility means a lower option premium
- Gains and losses across currencies offset in the payoff
- Saving shrinks if correlations rise; basis risk

IN THE LESSON

- Suppose a firm has exposures in several currencies.
- It could buy an option on each.
- Or it could buy one option on a basket of all the currencies.
- The reasoning is diversification.
- Exchange rates are imperfectly correlated, so the basket is less volatile than the weighted average of its parts, and an option's premium rises with volatility.
- A lower correlation means a cheaper basket option.
- The payoff depends on the aggregate basket, so gains on some currencies offset losses on others.
- Separate options would pay on each currency alone, and cost more for exposures that already cancel.
- The saving shrinks when correlations rise, as in a crisis, and the basket leaves some basis risk against the firm's actual cash flows.

17 Basket variance for two currencies

$$\sigma_b^2 = w_1^2 \cdot \sigma_1^2 + w_2^2 \cdot \sigma_2^2 + 2 \cdot w_1 \cdot w_2 \cdot \rho \cdot \sigma_1 \cdot \sigma_2$$

Weights	Share of exposure in each currency
Volatility, sigma	Standalone volatility of each
Correlation, rho	How the two currencies co-move
Basket variance	Basket risk, squared

IN THE LESSON

- To see how much the basket gains, use the variance formula for two currencies.
- Basket variance equals the first weight squared times the first variance, plus the second weight squared times the second variance, plus two times the two weights times the correlation times both volatilities.
- The weights show how the exposure is split.
- The volatilities are the standalone risks.
- The correlation runs from minus one to plus one, and it controls the last term.
- When correlation is below one, the last term shrinks, so the basket volatility is below the weighted average of the two volatilities.
- That gap is the discount the firm gets on the premium.

18 Example 7: correlation and basket volatility

Illustration: 50/50 basket, volatilities 10% and 8%, average 9%

Correlation	Basket volatility
+0.9	8.77%
+0.3	7.28%
−0.3	5.39%
Weighted average	9.00%

IN THE LESSON

- Take a fifty fifty basket of two currencies.
- The first has a volatility of ten per cent, and the second eight per cent.
- The weighted average of the two is nine per cent.
- If the correlation is point nine, the basket variance is point zero zero seven seven, a volatility of about eight point seven seven per cent, hardly any saving.
- At a correlation of point three, the variance is point zero zero five three, a volatility of seven point two eight per cent.
- At minus point three, the variance is point zero zero two nine, a volatility of five point three nine per cent.
- So the lower the correlation, the cheaper the option.
- In a stress period correlations rise and the saving shrinks.

19 What moves exchange rates

- Relative inflation: higher inflation weakens it
- Relative interest rates: real rates draw capital in
- Relative income growth: faster growth raises imports
- Government: trade barriers, central bank selling
- Expectations and risk perceptions shift capital flows

IN THE LESSON

- In a floating system the exchange rate moves with the supply of and demand for currencies, and several forces sit behind that.
- Relative inflation matters.
- Higher domestic inflation makes exports less competitive and imports more attractive, so the currency tends to depreciate.
- Relative interest rates matter through capital flows.
- A higher real rate attracts foreign money and tends to lift the currency.
- A nominal rate that only matches higher expected inflation does not.
- Relative income growth matters through imports.
- Faster domestic growth lifts import demand, so more domestic currency is sold, and the currency tends to weaken.
- Government actions matter too, such as trade barriers, which cut import demand, and central bank intervention, where selling the domestic currency weakens it.
- Finally, expectations and risk perceptions can shift capital flows quickly.

20 Direction of each factor

Effect on the home currency of a rise in each factor

Rise in...	Home currency tends to...
Domestic inflation	Depreciate
Real interest rate	Appreciate
Domestic income growth	Depreciate
Trade barriers	Appreciate
Selling by central bank	Depreciate

IN THE LESSON

- Let's fix the directions.
- For the home currency, a rise in domestic inflation relative to abroad tends to push it down.
- A rise in the real interest rate relative to abroad tends to push it up, because capital flows in.
- Faster domestic income growth relative to abroad tends to push it down, since imports rise.
- Trade barriers that reduce imports tend to lift it.
- Central bank selling of the home currency pushes it down, and buying lifts it.
- Expectations and risk perceptions can swing money in or out very fast.
- There are two traps.
- Do not use nominal rates when the real rate is what counts, and do not ignore the risk premium behind a rise in yields, because a yield rise driven by risk can weaken the currency.

21 Example 8: appreciation is not symmetric

Illustration: EUR/USD rises from 1.10 to 1.21

Base (EUR) change	(1.21 − 1.10) ÷ 1.10	**+10.00%**
Quote (USD) change	1.10 ÷ 1.21 − 1	**−9.09%**
Direction (rate up)	base up, quote down	**EUR up**

IN THE LESSON

- Now the arithmetic of appreciation.
- With euro dollar at one point one zero, the euro is the base.
- Suppose the rate rises to one point two one.
- The euro's change is the end rate minus the start rate, divided by the start rate.
- That is one point two one minus one point one zero, over one point one zero, so the euro appreciates ten per cent.
- The dollar's change is the reciprocal calculation, the start rate divided by the end rate, minus one.
- One point one zero over one point two one, minus one, is minus nine point zero nine per cent.
- The euro rose ten per cent but the dollar fell only nine point zero nine.
- The percentages differ because each is measured against a different base.
- A higher rate means the base appreciated and the quote currency depreciated.

22 Example 9: cross changes and foreign returns

Illustration: compounding currency moves and local returns

A vs B: A +3%, B −2% vs C	1.03 ÷ 0.98 − 1	**+5.10%**
Local return +8%, EUR −5%	1.08 × 0.95 − 1	**+2.60%**
Wrong: adding the percents	8% + (−5%)	**3.00%**

IN THE LESSON

- Changes compound, they do not simply add.
- Suppose currency A appreciates three per cent against C, and currency B depreciates two per cent against C.
- Then A against B is one point zero three divided by point nine eight, minus one, which is five point one zero per cent.
- Not five.
- Next, a foreign asset.
- A United States investor holds a euro asset that returns eight per cent in euros, while the euro falls five per cent against the dollar.
- The domestic return is one point zero eight times point nine five, minus one, which is two point six per cent.
- Adding eight and minus five gives three per cent, which is wrong.
- The usual mistakes are dividing by the wrong base, adding percentages, and getting the direction backwards.

23 Purchasing power parity (PPP)

Absolute: $S = P_{dom} \div P_{for}$
Relative: $S_1 = S_0 \times (1 + \pi_{dom}) \div (1 + \pi_{for})$
Approx: $\Delta S \approx \pi_{dom} - \pi_{for}$

Spot rate	Domestic currency per foreign unit
Domestic inflation, π_{dom}	Domestic inflation, pi dom
Foreign inflation, π_{for}	Foreign inflation, pi for
Expected end rate, S_1	Expected end rate, S1

IN THE LESSON

- Purchasing power parity says that exchange rates adjust so identical goods cost the same across countries.
- In the absolute form, the rate in domestic currency per unit of foreign currency is the domestic price level divided by the foreign price level.
- The relative form applies the idea to changes.
- The percentage change in the exchange rate is roughly domestic inflation minus foreign inflation.
- The exact form says the end rate equals the start rate times one plus domestic inflation, divided by one plus foreign inflation.
- So the higher inflation country's currency is expected to depreciate.
- Purchasing power parity is a long run tendency and often fails in the short run.
- Do not invert the ratio, and use the exact form when inflation is high.

24 Example 10: applying purchasing power parity

Illustration: start rate USD per EUR 1.10; US inflation 8%, euro area 2%

Absolute parity rate	330 ÷ 300	**1.10**
Expected end rate	1.10 × 1.08 ÷ 1.02	**1.1647**
EUR appreciation	1.08 ÷ 1.02 − 1	**+5.88%**
Approximation	8% − 2%	**6%**

IN THE LESSON

- Illustrate the absolute form first.
- A basket costs three hundred and thirty dollars at home and three hundred euros abroad.
- The parity rate is three hundred thirty over three hundred, one point one zero dollars per euro.
- Now the relative form.
- Start at one point one zero.
- Domestic inflation is eight per cent and foreign inflation is two per cent.
- The end rate is one point one zero times one point zero eight over one point zero two, which is one point one six four seven.
- The foreign currency appreciates by one point zero eight over one point zero two, minus one, which is five point eight eight per cent.
- The simple difference, eight minus two, gives six, a close but slightly high answer.
- Higher domestic inflation means the domestic currency depreciates.

25 Example 11: nominal and real interest rates

Illustration: exact Fisher relationship, real = (1 + nominal) ÷ (1 + inflation) − 1

Nominal 30%, inflation 20%	1.30 ÷ 1.20 − 1	**8.33%**
Approximation	30% − 20%	**10%**
Nominal 5%, inflation 2%	1.05 ÷ 1.02 − 1	**2.94%**
Approximation	5% − 2%	**3%**

IN THE LESSON

- Interest rates have a nominal side and a real side.
- The nominal rate is the stated rate.
- The real rate adjusts for inflation and measures the growth in purchasing power.
- The Fisher relationship works through growth factors.
- One plus the nominal rate equals one plus the real rate, times one plus expected inflation.
- The approximation is that nominal equals real plus inflation.
- Rearranged exactly, the real rate is one plus the nominal rate, divided by one plus inflation, minus one.
- With a nominal rate of thirty per cent and inflation of twenty, the real rate is one point three over one point two, minus one, or eight point three three per cent, not ten.
- At five per cent and two per cent, the exact real rate is two point nine four, close to three.

26 Covered interest rate parity: the forward rate

F = S × (1 + i_D) ÷ (1 + i_F)
or F = S × e^{(r_D − r_F) × T}

Spot rate	Spot, home per foreign unit
Home interest rate	Home interest rate for period
Foreign interest rate	Foreign interest rate for period
Forward rate	No-arbitrage forward rate

IN THE LESSON

- Interest rate parity follows from no arbitrage.
- An investor can earn the domestic rate at home.
- Or the investor can convert to foreign currency at spot, earn the foreign rate, and sell the proceeds forward.
- Since both covered returns are certain, they must be equal.
- With a direct quote and simple interest over the period, the forward rate is the spot rate times one plus the domestic rate, divided by one plus the foreign rate.
- With continuously compounded rates and time in years, it is spot times the exponential of the rate difference times time.
- The currency with the lower interest rate is at a forward premium, and the higher rate currency at a discount.
- Use the period fraction for contracts under a year, and do not invert the ratio.

27 Example 12: the forward and an arbitrage

Illustration: S = 1.0842, USD 4%, EUR 2%, 3 months (0.25 year)

Parity forward	1.0842 × 1.01 ÷ 1.005	**1.0896**
Market forward	above parity	**1.0950**
Euros at maturity	1,000,000 ÷ 1.0842 × 1.005	**€926,951**
Sell at 1.0950, repay loan	1,015,011 − 1,010,000	**+$5,011**

IN THE LESSON

- Let's compute a forward.
- Spot is one point zero eight four two.
- The dollar is the home currency at four per cent a year, the euro two per cent, and the term is three months, a quarter of a year.
- The forward is one point zero eight four two times one point zero one, over one point zero zero five, which is one point zero eight nine six.
- That sits right at the middle of the forward bid and ask we saw, one point zero eight nine two over one point zero nine zero one.
- Now the market forward is one point zero nine five zero, above parity.
- Borrow a million dollars, buy euros, and invest them.
- That makes about nine hundred twenty six thousand, nine hundred fifty euros.
- Sell them forward at one point zero nine five zero for about one million, fifteen thousand dollars, and the loan costs one million, ten thousand.
- Profit is about five thousand dollars, riskless.

28 Covered versus uncovered parity

Same ratio; very different strength

	Covered | Uncovered
Uses	Forward rate | Expected spot
Hedged?	Yes | No
Enforced by	Arbitrage | Nothing
In practice	Holds | Often fails

IN THE LESSON

- Now distinguish the two forms of parity.
- Covered interest rate parity links spot, forward and the two interest rates.
- It is enforced by riskless arbitrage, so it holds closely in normal markets with no view on future rates.
- Uncovered interest rate parity says that the expected future spot rate follows the same ratio, so the high interest rate currency is expected to depreciate by the interest gap, and an unhedged investment earns the same expected return as a domestic one.
- But nothing enforces it.
- It rests on expectations and on risk neutral investors, and it often fails empirically.
- Covered parity is an arbitrage condition.
- Uncovered parity is a hypothesis.

29 Example 13: the risk left uncovered

Illustration: USD 1,000,000; spot 1.0842; EUR leg left unhedged

Safe USD path (4% a year)	1,000,000 × 1.01	**$1,010,000**
Euro path, spot 1.0896	926,951 × 1.0896	**≈ $1,010,000**
Euro path, spot 1.0700	926,951 × 1.0700	**$991,837**
Shortfall vs safe path	991,837 − 1,010,000	**−$18,163**

IN THE LESSON

- See why uncovered parity is only a hypothesis.
- A United States investor with one million dollars can lend at home at four per cent a year, or one per cent a quarter, and get one million, ten thousand dollars with certainty.
- The alternative is to buy euros at one point zero eight four two and invest at the two per cent euro rate, ending with about nine hundred twenty six thousand, nine hundred fifty euros.
- Parity says the expected spot in three months is one point zero eight nine six, so the expected result is the same one million, ten thousand.
- Suppose, though, that the euro actually ends at one point zero seven zero zero.
- The euros convert to about nine hundred ninety one thousand, eight hundred dollars, a loss of about eighteen thousand against the safe path.

30 Four mistakes to avoid

- Wrong quote side: buyer pays ask; invert and swap sides
- Wrong base, added percents: compound; mind direction
- Nominal vs real: use exact Fisher and parity forms
- Parity ratio inverted; uncovered parity is no certainty

IN THE LESSON

- Mistake one: using the wrong side of a quote, or inverting without swapping the bid and the ask.
- The client buying the base pays the ask, and the inverse bid is one over the old ask.
- Mistake two: dividing by the wrong base, adding percentages, or ignoring that appreciation of one currency is depreciation of the other.
- Mistake three: mixing nominal and real rates, or using the approximation at high inflation.
- Use the exact Fisher and parity forms.
- Mistake four: inverting the parity ratio, or treating uncovered parity as a certainty.
- Covered parity is enforced by arbitrage, and the forward has the domestic rate on top.
- Uncovered parity leaves the exchange risk open.

31 Recap: the main ideas

- Quote: quote currency per base; dealer's side
- Spread = ask − bid; swap = two legs; outright = open
- Transaction, translation, economic: own hedges
- PPP and Fisher link rates to inflation
- Covered parity sets forward; uncovered is a hypothesis

IN THE LESSON

- Here are the main ideas.
- A quote is the price of one unit of the base in the quote currency, read from the dealer's side.
- Spreads are ask minus bid and are wider for forwards.
- Swaps use two opposite legs, and outrights leave an open position.
- Currency risk is transaction, translation or economic, and each has its own hedge, with baskets helping when correlation is low.
- Exchange rates move with relative inflation, real interest rates, growth, government actions and expectations.
- Appreciation is not symmetric, and changes compound.
- Purchasing power parity ties the rate to inflation.
- The Fisher relationship links nominal and real rates.
- Covered parity gives the forward by no arbitrage, and uncovered parity is only a hypothesis about expected spot.

32 Try three quick questions

1. Quote 1.2000 / 1.2004. Cost of buying 1,000,000 of base?
   Answer: Client pays the ask: 1,000,000 × 1.2004 = 1,200,400.
2. S = 1.2000, home 5%, foreign 3%, 1 year. Forward?
   Answer: 1.2000 × 1.05 ÷ 1.03 = 1.2233.
3. Home inflation 10%, foreign 4%. Foreign currency change?
   Answer: 1.10 ÷ 1.04 − 1 = +5.77%.

IN THE LESSON

- Now try three quick questions yourself.
- Pause after each one.
- Question one.
- A quote reads one point two zero zero zero over one point two zero zero four.
- What does a client pay to buy one million of the base currency?
- The client pays the ask, one million, two hundred thousand, four hundred.
- Question two.
- Spot is one point two zero zero zero, the home rate is five per cent and the foreign rate is three per cent, for one year with simple interest.
- What is the forward?
- It is one point two zero zero zero times one point zero five over one point zero three, which is one point two two three three.
- Question three.
- Inflation is ten per cent at home and four per cent abroad.
- By how much does the foreign currency appreciate against the home currency?
- One point one zero over one point zero four, minus one, which is five point seven seven per cent.
- The answers are on the board.