

LEHMAN BROTHERS

FOREIGN EXCHANGE TRAINING MANUAL

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FOREIGN EXCHANGE SPOT

INTRODUCTION

FX SPOT

AN INTRODUCTION TO FOREIGN EXCHANGE SPOT TRANSACTIONS

INTRODUCTION

Money has been around in one form or another since the days of the Pharaoh, replacing former systems of bartering. But, as history progressed and scores of countries generated their own individual monies, Middle Eastern money changers found a market exchanging coins of one culture for those of another—the first foreign exchange ‘market’. Over the ages, the form of money changed from coin form to bill form, the latter flourishing in the Middle Ages. But trading and speculation across foreign currencies began to increase after World War I. This speculation was not looked upon favorably by world markets, giving rise to the Bretton Woods Accord, a proposal undertaken towards the end World War II pegging major currencies to the U.S. dollar. The dollar was in turn pegged to gold at \$35 per ounce. This accord allowed currencies to fluctuate by one percent on either side of the standard, mandating that respective central banks intervene if the fluctuation was outside of those limits. Although the Bretton Woods accord accomplished the goals of its charter to re-establish economic stability in post-war Europe and Japan, it ultimately failed. Other similar failed agreements were attempted in the following decades, but, ultimately in 1973, the world defaulted to free-floating currencies. *

All major currencies now move independently of other currencies, being traded by anyone who wishes. Now, hedge funds, banks, brokerage houses, corporations, and individuals all participate in the foreign exchange market either on a speculative basis, to facilitate transactions, or to hedge against currency risks associated with their core business.

Foreign exchange is a business of exchanging one currency for another. This exchange can take two basic forms: an outright or a swap. When two parties simply exchange one currency for another the transaction is an outright. For example, if one party gives the other dollars for Euros, they have completed an *outright* transaction. If this exchange takes place for immediate delivery, it is called a *spot* transaction; if it takes place for forward delivery, it is called a *forward*.

Two parties can also agree to exchange and re-exchange one currency for another. For example, one party gives the other dollars for Euros for immediate delivery and simultaneously agrees to re-exchange Euros for dollars at a specified rate at some time in the future. These transactions are called *swaps*.

The first part of this workbook will focus on spot exchanges.

* Source: gftforex.com

WHAT IS AN OUTRIGHT?

An outright currency transaction involves two parties exchanging one currency for another. The two parties must agree on the two currencies, the amount of one currency, the settlement date, and the exchange rate. The amount of the second currency will be derived from a calculation involving the amount of the first currency and the exchange rate.

Outright rate of exchange/spot: the amount of one unit of currency expressed in terms of the other.

Outright Transaction: the exchange of one currency for the other at the outright rate of exchange.

VALUE DATES

The value date is the day the two parties actually exchange the two currencies. It is impractical, in most circumstances, for the value date and the trade date to be the same. The forward value date is usually required to allow both parties time to arrange for payments which often occur in different time zones.

By market convention, foreign exchange trades settle two mutual business days ($T + 2$) after that trade date unless otherwise specified. This is commonly referred to as value for spot. The spot exchange rate is the benchmark price the market uses to express the underlying value of the currency. Rates for dates other than the spot are always calculated relative to the spot rate.

Listed below are the various value dates available in the market—they are all determined relative to the deal date. ***Assume the deal date is Monday, December 12.***

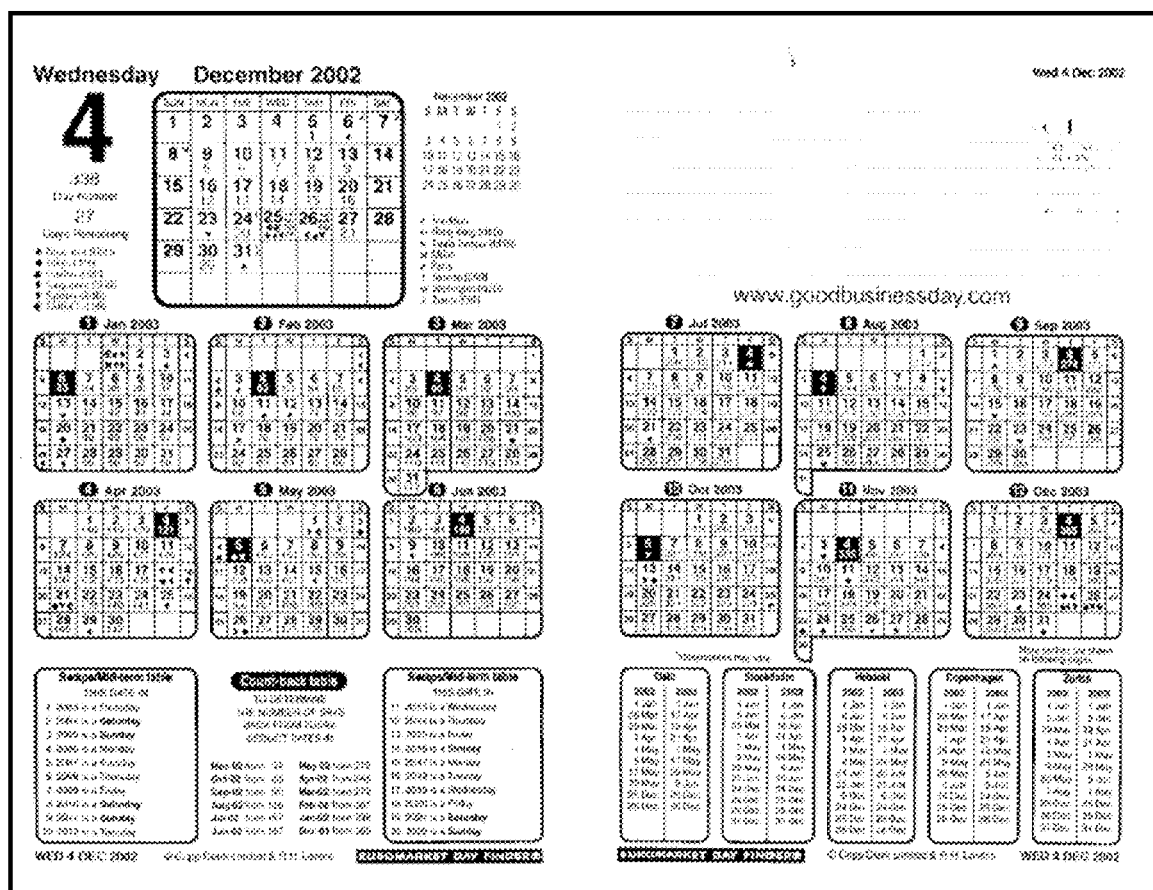
Settlement	Settlement/Value Date	Definition
Cash	December 12	Deal Date
Value "Tomorrow Next"	December 13	One Mutual Business Date After Deal Date [#]
Spot	December 14	Two Mutual Business Days After Deal Date ⁺⁺
Forward Outright	December 15 or Later	Three Business Days or More After Deal Date; Always Longer Than Spot

[#] The Settlement Date May Not Fall on a Day That is a National Holiday in Either Country.

⁺⁺ Exception: Spot for the Canadian Dollar Against the USD is One Business Day Later. Assuming Today is Monday, December 12, Spot Would be December 13.

QUESTIONS

Using the trader's calendar below, indicate the date on which each of these trades would settle.
Assume you are at a New York bank dealing in currencies against the US dollar.
Today is December 4th.



1. You do a trade in CAD for cash settlement _____
2. You do a spot CAD trade _____
3. You do a GBP trade for value tomorrow _____
4. You do a spot GBP trade _____
5. You do a spot CHF trade _____

ANSWERS

- 1) December 4
- 2) December 5
- 3) December 5
- 4) December 6
- 5) December 6

CREDIT AND SETTLEMENT RISKS

Foreign Exchange contracts represent a *Credit Risk* between Lehman and the client. The risk is equal to the replacement cost of any deal in the event that the client cannot fulfill its obligations. For spot transactions, the exposure is for only the two days between the trade date and the value date.

However, for forward contracts the exposure is greater because the time between the trade date and the value date is greater. For example, if Lehman contracted to buy USD/sell EUR one year forward at 1.0425 and the current forward rate is 1.0845, Lehman has a gain of over 4% of the face value of the contract. If the client cannot fulfill the contract, Lehman must replace the forward at the rate currently available and, therefore, stands to lose the 4% mark-to-market gain. Since the bank reports mark-to-market gains as income, client nonperformance has bottom line implications.

Settlement Risk is another form of credit risk which can potentially be much greater. Each currency deal actually involves two settlements, since each currency settles in its home country. Since the exchange of currencies cannot be simultaneous due to time differences, each party is at risk for the time period between the two settlements. For example, assume you have sold JPY against the USD. The JPY will settle in Japan—your JPY account will be debited and the JPY delivered to the bank of the buyer—hours before your dollar account in New York is credited. Your risk is that you deliver JPY to the Japanese clearing, but the bank which owes you dollars in return for your JPY declares bankruptcy by the opening of business in NY. You have paid out the JPY but will not receive your dollars in exchange.

EXCHANGE RATE QUOTATION TERMS

- The major currency pairs can be quoted in either *European* or *American* terms.
- Those that quote in number of US dollars per one unit of another currency is American. An example of this is EUR/USD which is quoted as the number of USD per one Euro.
- A currency quoted as the number of units of a specific currency per one USD is quoted in American terms. An example of this would be dollar-yen, which is quoted in yen per one USD. When rates are spoken the base currency comes first. It is imperative that you remember these conventions!

American Terms	European Terms	Other Major Cross Rates
EUR/USD-“Euro-Dollar”	USD/JPY-“Dollar-Yen”	EUR/NOK-“Euro-Nockie”
AUD/USD-“Aussid-Dollar”	USD/CAD-“Dollar-Cad” ^{##}	EUR/SEK-“Euro-Stockie”
NZD/USD-“Kiwi-Dollar”	USD/CHF-“Dollar-Swiss” ^{\$}	USD/MXP-“Dollar-Mex”
GBP/USD-“Sterling, Cable”	USD/SEK-“Dollar-Stockie”	USD/ZAR-“Dollar-Rand”
	USD/NOK-“Dollar-Nockie”	GBP/JPY-“Sterling-Yen”
		EUR/GBP-“Euro-Sterling”

The arithmetic way to express these quotations will always have the base currency in the denominator and the rates currency in the numerator. Do not allow this representation to confuse you when actually saying the currency pairs. This is simply how they would look mathematically. Examples are USD/EUR and JPY/USD being the nomenclature for arithmetic expression of Dollars per Euro and JPY per USD, respectively. The following will illuminate this point.

Since two currencies are involved, one has to be quoted in terms of the other. When we say that the exchange rate for the yen against the dollar is 123.50 yen, we are valuing the dollar in terms of the yen—123.50 yen per dollar. The arithmetic expression tells you which currency is being quoted in terms of the yen. In the case of the USD/EUR, the EUR is being quoted in terms of the USD.

The way the two currencies are referred to verbally will usually tell you which one is the base, since the base currency is usually stated first. For example, when the two currencies involved are the US dollar and the yen, the relationship is called dollar-yen—meaning the number of yen per dollar. This tells you that the dollar is the base and that the rate will be quoted in terms of yen per dollar.

Do not let the terminology confuse you; a “dollar-yen” rate is quoted as Yen per USD.

^{##} Also Known as the ‘Loon’.

^{\$} Sometimes Known as the ‘Fondue Franc’

- The currency in the *numerator* always states how much of that currency is required for one unit of the base currency.

U.S. terms: the dollar is in the numerator; for example, USD/GBP-- giving the units of dollar per pound.

European Terms: the non-dollar currency is in the numerator; for example, JPY/USD, giving the units of yen per dollar.

$\frac{\text{Numerator}}{\text{Denominator}} = \frac{\text{Terms Currency}}{\text{Base Currency}}$
--

QUESTIONS

- In many cases, you will see only the terms account; it is assumed you know the base. For example, if you see JPY124.25 you know that this means 124.25 Yen per \$1.

1. GBP 1.5541: base _____: quoted in _____ terms.

2. CAD 1.5476: base _____: quoted in _____ terms.

3. AUD 0.5565: base _____: quoted in _____ terms.

4. EUR 1.0500: base _____: quoted in _____ terms.

ANSWERS

1. Sterling; US terms
2. USD; European terms
3. AUD; US terms
4. EUR; US terms

RECIPROCAL QUOTATION TERMS (RATES)

- The method of quotation can be changed from US to European terms, or vice versa, simply by calculating the *reciprocal* of the rate. For example, Canadian dollars are usually quoted in European terms, that is, the number of Canadian dollars per one US dollar.

$$\text{CAD/USD} = 1.5672$$

- However, at least for Canadian banks, you sometimes see it quoted in US terms. That is, the number of USD per CAD.

To take the reciprocal:

$\begin{array}{rclcl} 1 / 1.5672 & = & 0.6381 & = & \\ 0.6381 \text{ USD per 1 CAD} & & & & \end{array}$
--

EXCHANGE RATE MOVEMENTS

- The exchange rate is constantly changing, which means the value of one currency in terms of the other is in constant flux. When this relationship changes, the market speaks of one currency as strengthening or weakening vis-à-vis the second currency. For example, if the dollar strengthens, by definition, the other currency must have weakened.
- Whenever the base currency buys more of the terms currency or whenever there is an increase in the numerator, the base currency has strengthened and the terms currency has weakened. For example, if dollar-yen opened at 124.10 and closed at 124.60, you would say that the dollar strengthened since one dollar buys more yen at the close than it did at the open. In this case, the dollar closed higher or “up.”
- Based on their outlook on a currency, traders will often take positions in that currency, buying it if they think it will strengthen and selling it if they think it will weaken.
 - Assume an FX trader bought one million dollar's worth of Swiss Francs at 1.4996 at the open because she thought Francs would strengthen over that day. However, her outlook for the day was wrong, and when she closed out her position by buying back the dollars at 1.5040 she experienced a \$2,925.53 (CHF4,400) loss.

$$\begin{array}{rcl}
 \text{CHF loss:} & -\$1,000,000.00 & = +\text{CHF}1,499,600 @ 1.4996 \\
 & +\$1,000,000.00 & = -\text{CHF}1,504,000 @ 1.5040 \\
 & -0- & -\text{CHF}4,400
 \end{array}$$

- The Swiss loss can then be converted into a dollar loss by dividing the Swiss loss by the ending exchange rate.

$\text{CHF } 4400 / 1.5040 = \2925.53

QUESTIONS

- Based on the rates given below, decide which currency strengthened and which one weakened, whether it closed up or down, and your profit/loss based on the position you took at the open.

Remember: When the rate increases, the base strengthens, and the terms weakens.

1. Sterling opens at 1.5409 and closes at 1.5425.

The dollar _____ and the pound _____. Therefore, the Dollar closed (up/down) for the day, relative to the GBP. If you sold 1MM GBP and bought USD at the open and the reversed the trade at the close, your (profit/loss) would be _____(currency and amount).

2. Dollar-yen opens at 124.05 and closes at 123.50.

The Dollar _____ and the yen _____. Therefore, the Yen closed (up/down) for the day, relative to the USD. If you sold USD 1MM at the open and reversed the position at the close, your (profit/loss) would be _____.

3. CHF/USD opens at 1.5030 and closes at 1.5035.

The USD _____ and the Swiss Franc _____. Therefore, the Dollar closed (up/down) for the day, relative to the CHF. If you sold CHF 10MM at the open and bought them back at the close, your (profit/loss) would be _____.

ANSWERS

1. The Dollar weakened and the Pound strengthened, since one Pound will buy more Dollars. The Dollar closed down for the day. You had a loss of £1,037.28 or \$1,600.

$$\begin{array}{rcl}
 -£1,000,000 = +\$1,540,900 @ 1.5409 & -£1,000,000 @ 1.5409 = +\$1,540,900 \\
 +£998,963 = -\$1,540,900 @ 1.5425 & +£1,000,000 @ 1.5425 = -\$1,542,500 \\
 \hline
 -£1,037 = 0 & 0 = -\$1,600
 \end{array}$$

2. The Dollar weakened and the Yen strengthened, since one Dollar will buy fewer Yen. The Yen closed up for the day. You had a profit of ¥550,000 or \$4,453.

$$\begin{array}{rcl}
 -\$1,000,000 = +¥124,050,000 @ 124.05 & -\$1,000,000 @ 124.05 = +¥124,050,000 \\
 +\$1,004,453 = -¥124,050,000 @ 123.50 & +\$1,000,000 @ 123.50 = -¥123,500,000 \\
 \hline
 +\$4,453 = 0 & 0 = +¥550,000
 \end{array}$$

3. The dollar strengthened and the Swissie weakened since one Dollar will buy more Swissie. The Dollar closed up for the day. You had a profit of CHF3,327 or \$2,213.

$$\begin{array}{rcl}
 -CHF10,000,000 = +\$6,653,360 @ 1.5030 & -CHF10,000,000 @ 1.5030 = +\$6,653,360 @ 1.5030 \\
 +CHF10,003,327 = +\$6,653,360 @ 1.5035 & +CHF10,000,000 @ 1.5035 = +\$6,651,147 @ 1.5035 \\
 \hline
 +CHF3,327 = 0 & 0 = +\$2,213
 \end{array}$$

In the problems above we saw the following market moves:

	Open	Close
GBP/USD	1.5409	1.5425
JPY/USD	124.05	123.50
CHF/USD	1.5030	1.5035

- Dealers refer to small moves as pips. For example, in the case of USD/GBP, Sterling moved 16 pips whereas in the case of the USD/JPY, the market moved 55 pips. One hundred pips is a "point" or a "big figure." Note that pips or points can be a different decimal place depending on the quoting convention of the market. In the Sterling market, one pip is 0.0001 but in the Yen market, one pip is 0.01.

SHORTCUT

On the preceding page, you calculated the profit and loss due to a change in the rates. There is a shortcut method to calculating these gains and losses.

$$\text{Base currency gain/loss} = \% \text{ change} * \text{base amount}$$

Where $\% \text{ change} = (\text{pip change} / \text{closing rate})$

$$\text{Terms currency gain/loss} = \text{pip change} * \text{base amount}$$

- *Example:* In the Sterling case, the opening rate was 1.5409, the closing rate was 1.5425, for a 16 pip change.
 - Base gain/loss = £1,037
 - Terms gain/loss = \$1,600
- *Note:* It is mathematically equivalent (and possibly more understandable) to find the Base gain/loss by multiplying the pip change by the notional and dividing that figure by the closing exchange rate $[(0.0016 * 1,000,000) / 1.5425]$. Since the exchange rate is measured in Dollar terms, the pip change is the Dollar gain/loss. Multiply that dollar gain/loss by the notional to get the total USD gain/loss. Divide that gain/loss by the closing rate to get the amount of Sterling that equates to.

QUESTIONS

Using the shortcut method, re-calculate the following gains or losses.

1. JPY/USD opens at 124.11 and closes at 123.80; you bought one million dollar's worth of Yen on the open and sold it on the close.
2. CHF/USD opens at 1.5000 and closes at 1.5035; you sold 1,000,000 USD at the open and bought it back at the close.

ANSWERS

- | | | | |
|----|---------------------|--------------------------------|--------------|
| 1. | Base currency gain | = $.31/123.80 * \$1,000,000$ | = \$2,504 |
| | Terms currency gain | = $.31 * \$1,000,000$ | = JPY310,000 |
| 2. | Base currency loss | = $.0035/1.5035 * \$1,000,000$ | = (\$2,328) |
| | Terms currency loss | = $.0035 * \$1,000,000$ | = (CHF3,500) |

BIDS AND OFFERS

- When making a market in a currency, market-makers (traders) quote two rates:

Bid	Rate at Which Market Maker Will Buy the Base Currency
Offer	Rate at Which Market Maker Will Sell the Base Currency

- The difference between the bid and the offer is called the *spread*.

USD/GBP = 1.5464/74, so the spread is 0.0010 USD/GBP.
JPY/USD = 123.50/123.60, so the spread is 0.10 JPY/USD.

The market may move 10 pips, with the new quote being 1.5474/84, but the spread remains the same under normal market conditions.

Also, note that although the spread in both markets above is 10 pips, the value of 10 pips in the USD/GBP is different from the value if the 10 pips in the JPY/USD market. However, in the market, spreads are generally comparable between currencies on a percentage basis. In general, greater uncertainty among traders is reflected in wider spreads in the market.

The size of the spread reflects:

- The *liquidity* of that currency—the more liquid the currency, the narrower the spread.
- The *size* of the deal—the bigger the transaction, the wider the spread because the dealer is taking on more risk.
- The *time* of the day—spreads tend to be widest in the New York afternoon because both Europe and Asia are closed or during the Asian lunchtime.

THE RULE OF THE LEFT BID – RIGHT OFFER

- Market makers always trade the base currency. They buy the base currency on the left side of the quote and sell the base currency on the right side of the quote.

Example I: If a market maker quotes Sterling at 1.5460/70, he will buy Sterling at \$1.5460 per pound and sell Sterling at \$1.5670 per pound. This means *you* can buy Sterling at 1.5470 (offer) and sell it at 1.5460 (bid).

Example II: If a market-maker quotes the dollar against the CHF at 1.5044/50, he will buy the dollars at 1.5044 CHF per dollar but sell them for 1.5050 CHF per dollar. This means *you* can buy them at 1.5050 CHF per dollar and sell them at 1.5044.

- To be sure about what side of the market you are dealing on, *always* think in terms of the base currency. This means every transaction can be thought of in terms of these rules:
 1. Determine what the market-maker is quoting as the base currency.
 2. Determine what you need to do in terms of the base currency.
 3. Remember that the market-maker buys the base on the left and sells it on the right.
- In Example I, the market-maker is quoting the dollar as the base. You have the USD and need the CHF, so you must sell the USD and buy the CHF. You deal on the market-maker's bid (left).
- In Example II, the market-maker is quoting the Sterling as the base. You have the USD and want the Sterling, so you must buy the Sterling. The market-maker will sell them to you at the offered (right) side of the market.

QUESTIONS

On which rate would you deal in each of the problems below?

1. You have just received a 1,000,000 GBP payment. You want to convert these pounds into dollars. You get a quote of 1.5457/61.
2. You have to buy Australian dollars to make a large payment. The quote is .5535/37.
3. You need to make a SEK payment. You get a quote of 9.3854/9.3934.
4. You have received a large JPY denominated dividend which you want to convert into dollars. The quote is 123.19/23.

ANSWERS

1. 1.5457 USD/GBP

The base currency is GBP. You want to sell GBP and buy USD. You will deal on the bid (left) side of the market; that is where the trader is buying the GBP from you.

2. .5537 USD/AUD

The base currency is the AUD. You want to buy AUD. You will deal on the offered (right) side of the market; that is where the trader is selling the AUD to you.

3. 9.3854 SEK/USD

The base currency is the US\$. You need to buy SEK to make the payment and sell USD. You will deal on the bid (left) side of the market; that is where the trader is selling SEK and buying USD from you.

4. 123.23 JPY/USD

The base currency is the USD. You want to sell JPY and buy USD. You will deal on the offered (right) side of the market; that is where the trader is selling USD.

QUESTIONS

1. Decide where the client will deal:

Client wants to:	Current Lehman quote:	Clients deals at:
Buy 5 GBP versus USD	1.5471/73	
Sell 10 USD versus JPY	125.06/12	
Sell 7 NOK versus USD	7.5946/78	
Buy 1 USD versus CAD	1.5626/32	
Sell 5 EUR versus SEK	9.1268/9.1318	

2. A corporation obtains the following quotes from a competition bank. Decide whom and at which rate the client will deal at.

Client wants to:	Current Lehman quote:	Competition quote:	Client deals at:
Buy 5 GBP versus USD	1.5471/73	1.5472/75	
Sell 10 USD versus JPY	125.06/12	125.01/05	
Sell 7 NOK versus USD	7.5946/78	7.5950/80	
Buy 1 USD versus CAD	1.5626/32	1.5620/25	
Sell 5 EUR versus SEK	9.1268/9.1318	9.1260/9.1300	

3. How much did the corporation save in each case (in \$ or in foreign currency)?

GBP:

JPY:

NOK:

CAD:

EUR:

ANSWERS

1. The corporation would deal at these rates:

GBP: 1.5473

JPY: 125.06

NOK: 7.5978

CAD: 1.5632

EUR/SEK: 9.1268

2. Given the competing rates, the corporation would deal at:

GBP: 1.5473

JPY: 125.06

NOK: 7.5978

CAD: 1.5625

EUR/SEK: 9.1268

3. How much did the corporation save?

GBP: \$500

JPY: ¥500,000

NOK: 24.25 NOK

CAD: 700 CAD

EUR/SEK: 4000 SEK

CROSS RATES

So far, the exchange rates we have examined have involved the dollar as either the base or the terms currency. However, the dollar is not always involved. When people talk about the price of one foreign currency in terms of another and neither of the currencies is the dollar, it is called a *cross rate*.

- “Euro-yen” is a classic, widely traded cross-rate whose price movements reflect the market’s view on the Euro and the yen against various currencies. “Euro-yen” is a cross rate between the EUR/JPY.
- Most commonly, traders derive cross rates using the two rates versus the USD because those two rates are known. We will look first at how to derive them algebraically and then at a shortcut rule. With cross rates, it is crucial to remember the base currency conventions.

Same terms (both are quoted in either US or European terms):

Example:

- Assume you want the CHF/JPY cross; that is, the number of JPY for 1 CHF.
 - $1.5029 \text{ CHF} = 1 \text{ USD}$
 - $125.22 \text{ JPY} = 1 \text{ USD}$
 - Therefore, $\text{CHF} = 125.22 \text{ JPY}$
 - $1 \text{ CHF} = 125.22 / 1.5029$
 - $1 \text{ CHF} = 83.3189 \text{ JPY}$
 - $\text{CHF/JPY} = 83.3189$

The shortcut rule is: If two currencies are quoted against the \$ on the *same terms*, *divide* the base currency into the terms currency of the cross currency pair.

Different terms (one currency is quoted in US terms and the other in European terms). For example:

- Assume you want the GBP/JPY cross rate; i.e., the number of JPY per 1 GBP.
 - $125.06 \text{ JPY} = 1 \text{ USD}$
 - $1 \text{ GBP} = 1.5467 \text{ USD}$
 - Therefore, $1 \text{ GBP} = 125.06 \text{ GBP} * \$1.5467 = 193.4303$
 - $\text{GBP/JPY} = 193.4303$

The short cut rule is: If two currencies are quoted on *different terms*, *multiply* one rate by the other.

QUESTIONS

Calculate the cross rates for the following currencies:

1. EUR/SEK

0.9772 EUR/USD
9.3622 USD/SEK

2. EUR/GBP

0.9772 EUR/USD
1.5465 USD/GBP

3. AUD/NZD

0.5535 USD/AUD
0.4841 USD/NZD

ANSWERS

1. 9.1487 EUR/SEK
2. 0.6318 EUR/GBP
3. 1.1433 AUD/NZD

*****Remember the shortcut rules:***

If two currencies are quoted in the same terms,
divide the base currency of the cross currency pair
into the terms currency of the pair.

If two currencies are quoted in different terms,
multiply one rate by the other.

BID-OFFER FOR THE CROSS RATES OF CURRENCIES ON SAME TERMS

So far we have ignored bid/offer spreads in calculating cross rates. The same rules apply—divide by the base rate for currencies in the same terms and multiply the rates for those in different terms—but now you have to figure out when to use the bid and when to use the offer of the first two currencies to create the bid/offer of the cross.

Example:

- Assume you are the market-maker, and you want to derive the cross-rate market for CHF/JPY.

	Bid for \$	Offer for \$
Dollar-yen	125.06	125.09
Dollar-Swiss	1.5026	1.5031

- First, always determine the base of the new cross. In this cross, the Swiss Franc is the base and the yen is the terms currency. Now work with what you know. Since CHF is the base, you know that 1) the currency being traded is the CHF, so 2) the bid and offer of the cross are for CHF. You also know the value of CHF and JPY relative to the dollar. You will use this information to derive the value of the CHF in terms of the JPY.

To get the bid side of the cross, buy the base and sell the terms of the cross.

- To get the JPY per CHF bid, you buy the CHF and sell JPY.
 - Buy CHF. As the market maker dealing in base currencies, to buy CHF you sell dollars on your offer at 1.5031.
 - Sell JPY. Again as the trader, when selling JPY, you buy dollars on your bid of 125.06.
 - You want to know the value of 1 CHF in terms of JPY. Since CHF and JPY are both in European terms, you *divide* the base of the cross into the terms of the cross to get the cross rate—CHF expressed in terms of JPY.

The bid for JPY/CHF:

$$\frac{\text{Sell Terms (JPY) / Buy USD}}{\text{Buy Base (CHF) / Sell USD}}$$

$$= \frac{125.06}{1.5031} = 83.2013 \text{ JPY/CHF bid}$$

- To get the offered side of the cross, sell the base and buy the terms.
 1. Sell CHF. From your perspective, you buy USD on your bid of 1.5026.
 2. Buy JPY. To buy JPY, you sell USD on the offer of 125.09.
 3. You want to know the value of 1CHF in terms of JPY.

The offer for JPY/CHF:

$\frac{\text{Buy JPY} / \text{Sell USD}}{\text{Sell CHF} / \text{Buy USD}}$

$$= \frac{125.09}{1.5026} = 83.2490 \text{ JPY} / \text{CHF offer}$$

- To simplify, always remember what to do with the base currency of the cross—then do the opposite with the terms currency.

Bid = *buy base* of the cross against the dollar
Offer = *sell base* of the cross against the dollar

- Another way to simplify is to think of presenting the Bid-Ask spread in the most favorable terms for the market maker. This is done by making the spread *as wide* as possible. So, If you are calculating a spread of currencies on the same terms, i.e. dividing, you would make the widest spread by dividing the larger number by the smaller number and the smaller number by the larger number. Doing so makes minimizes the bid and maximizes the offer. In our example this is done by dividing 125.06 by 1.5031 and 125.09 by 1.5026. Similarly, for currencies on different terms, where one multiplies the currencies to get the cross rate, one minimizes the bid by multiplying both of the smaller numbers against each other and both of the larger numbers against each other. We will see this is the next example.

EXCHANGE RATE MOVEMENT REVISITED FOR CROSSES

Cross rates also move such that one currency strengthens or weakens vis-à-vis the other one. As with dollar-based currencies, it is easier to conceptualize when you think of cross rate moves in terms of the base. For example, if “Swiss-yen” moves from 83.24 to 83.50, the Swiss Franc has strengthened since one Swiss Franc buys more yen. Similarly, a move from 83.24 to 83.00 is a weaker CHF/stronger JPY rate.

BID-OFFER FOR CROSS RATES OF CURRENCIES ON DIFFERENT TERMS

- The procedure for finding cross rate bid-offer spread for currencies in different terms is exactly the same except you *multiply* the two rates rather than divide.

Example:

- Assume you want to determine the bid/offer cross rate of EUR/CHF or “Euro-Swiss.” Within the cross, Euro is the base currency and the CHF is the terms currency.

	Bid for EUR	Offer for EUR
EUR/USD	<i>(Buy EUR/Sell USD)</i> 0.9791	<i>(Sell EUR/Buy USD)</i> 0.9796
	Bid for USD	Offer for USD
USD/CHF	<i>(Buy USD/Sell CHF)</i> 1.4984	<i>(Sell USD/Buy CHF)</i> 1.4991

- Bid of the Cross: buy the base and sell the terms of the cross.
 - Buy EUR. As the trader you buy the EUR on your bid of .9791.
 - Sell CHF. As the trader you sell CHF and buy USD on your bid of 1.4984.
 - Multiply the two rates and get the cross-rate bid.

$$1 \text{ EUR} = \$0.9791 * 1.4984 \text{ CHF}$$

$$\text{EUR/CHF} = 1.4671$$

- Offer of the Cross: sell the base and buy the terms.
 - Sell EUR. As the trader you sell the euro on your offer of .9796.
 - Buy CHF. As the trader you buy CHF and sell USD on your offer of 1.4991.
 - Multiply the two rates and get the cross-rate offer.

$$1 \text{ EUR} = \$0.9796 * 1.4991 \text{ CHF}$$

$$\text{EUR/CHF} = 1.4685$$

Note: Unlike currencies on the same terms where you use the bid of the terms and the offer of the base currency to get the bid of the cross, there is no “cross-over” for the currencies on different terms:

$$\begin{aligned} \text{Bid of base} * \text{bid of terms} &= \text{bid of cross} \\ \text{Offer of base} * \text{offer of terms} &= \text{offer of cross} \end{aligned}$$

SUMMARY

DIFFERENT TERMS

Bid: buy the base currency and sell the terms, *multiply* the two rates to get the cross.

Offer: sell the base currency and buy the terms, *multiply* the two rates to get the cross.

SAME TERMS

Bid: buy the base and sell the terms, *divide* by the base of the cross.

Offer: sell the base and buy the terms, *divide* by the base of the cross.

QUESTIONS

Determine the bid/offer cross rates.

1. What is the NOK/EUR cross?

	Bid	Offer
USD/EUR	0.9785	0.9789
NOK/USD	7.5853	7.5865

2. What is the JPY/CAD rate?

	Bid	Offer
CAD/USD	1.5675	1.5685
JPY/USD	125.11	125.17

ANSWERS

1. 7.4222-7.4264 NOK/EUR

bid: buy EUR on your bid at .9785
sell NOK/buy USD on your bid at 7.5853
 $1 \text{ EUR} = \$0.9785 * 7.5853 \text{ NOK}$
7.4222 NOK per one EUR

offer: sell EUR on your offer at .9789
buy NOK/sell USD on your offer at 7.5865
 $1 \text{ EUR} = \$0.9789 * 7.5865 \text{ NOK}$
7.4264 NOK per one EUR

2. 79.76-79.85 JPY/CAD

bid: buy CAD/sell USD on your offer at 1.5685
sell JPY/buy USD on you bid at 125.11
 $1 \text{ CAD} = 125.11 \text{ JPY} / \1.5685
79.76 JPY per one CAD

offer: sell CAD/buy USD at the 1.5675
buy JPY/sell USD at 125.17
 $1 \text{ CAD} = 125.17 \text{ JPY} / \1.5675
79.85 JPY per one CAD

SHORTCUTS

Although it is essential to be able to derive the cross rates, there are times when you cannot take the time to think—you have to be able to react immediately. These rules may help you:

- Currencies on *same* terms:
 - Offer base into bid terms = bid cross
 - Bid base into offer terms = offer cross

- Currencies on *different* terms:
 - Bid base times bid terms = bid cross
 - Offer base times offer terms = offer cross

TRADING CONVENTIONS AMONG MARKET MAKERS

An outright foreign exchange market is a two-sided foreign exchange quotation, consisting of two rates: the rate at which an institution will buy the base currency and the rate at which the same institution will sell the base currency. Market-makers, primarily major multinational commercial banks, stand ready to buy and sell given currencies against the dollar. Most are also prepared to make cross rate markets.

- With all market participants, market-makers:
 - Generally quote a two-sided market (with wider spreads in volatile markets),
 - Can change the quote up until the counterparty actually deals on the market quoted, and
 - Can be expected to hold the price for only three to four seconds.
- With other market-makers, they:
 - Make reciprocal agreements on the currencies, standard amount of the trade, and the size they will quote each other.
- *Majors -* EUR, USD, GBP, CHF, JPY
- *Periphery/ Commodity -* AUD, NZD, CAD
- *Emerging Markets, Latin America -* BRL, MXP, CLP, VEB
- *Emerging Markets, Asia -* KRW, TWD, INR, THB
- *Emerging Markets, Europe -* CZK, HUF, PLN
- This list is not extensive. Lehman Brothers will deal in any currency where local authorities have not placed restrictions on their currency.

SUMMARY

- An outright transaction involves two parties exchanging one currency for another.
- Settlement conventions (value dates) for all currencies are:
 - Cash = same date as deal date
 - Value tomorrow = one business day after deal date
 - Spot = two business days after deal date (except for CAD which is one day)
 - Forward = any day after spot
- Spot is used as the benchmark price representing the underlying value of the currency. Unless otherwise specified, a quoted exchange rate is assumed to be the spot rate.
- There is settlement risk in FX transactions because the deal involves two separate settlements—one in each country—which do not take place simultaneously.
- When two currencies are involved, one currency must be expressed in terms of the other.
 - The currency in the numerator = the terms currency
 - The currency in the denominator = the base currency
- Whenever it takes more of the terms currency to buy one unit of the base currency (whenever the numerator gets bigger), the terms currency has weakened and the base currency has strengthened.
- The opposite is also true. Whenever the base currency can buy more of the terms currency, the base has strengthened, the terms has weakened.
- Assuming one of the currencies involved is the USD, when the USD is in the numerator, the currency is quoted in USD terms; when the dollar is not in the numerator, the currency is quoted in European terms.
 - US terms: USD/GBP
 - European terms: CHF/USD
- When *speaking* of one currency in terms of another, the base currency is *usually* stated first.
 - “Dollar-Swiss”
 - “Sterling-dollar”
- Traders always think in terms of buying/selling the base currency.
 - Traders buy the base currency on their bid and sell the base currency on their offer.
 - Traders buy the base currency on their left and sell the base on their right.
 - Traders will always sell to you at a higher rate than they will buy from you.

- When asking for a rate, always think in the base currency from the customer's perspective.
- A cross rate is the price of one currency in terms of the other when neither one is the dollar.
 - To get the bid of the cross, you buy the base currency of the cross and sell the terms currency.
 - To get the offer of the cross, you sell the base currency of the cross and buy the terms currency.
 - If two currencies are quoted in the same terms, divide by the base currency to get the cross rate.
 - If two currencies are quoted in the different terms, multiply the rates to get the cross rate.
- To get the *bid/offer* on cross rates:
 - Same terms:
 - Offer of base currency into bid of terms currency = bid of cross
 - Bid of the base currency into offer of terms currency = offer of cross
 - Different terms:
 - Offer of base currency times bid of terms = bid of cross
 - Offer of base times offer of terms = offer of cross

REVIEW PROBLEMS

	Bid	Offer
USD / CHF	1.5025	1.5030
USD / JPY	125.18	125.20
USD / GBP	1.5475	1.5485
NZD / USD	0.4827	0.4837

1. Assuming the client had called Lehman for the above quotes, at what rate would you deal?
 - a) You want to buy GBP _____
 - b) You want to sell CHF _____
 - c) You want to buy JPY _____
 - d) You want to sell NZD _____

2. Using the same rates as above, determine the following bid/offer cross rates.
 - a) GBP/CHF
 - b) NZD/JPY
 - c) GBP/NZD

3. Today is Tuesday, October 22, 2002.
 - a) You do a "Dollar-yen" trade. What date will it settle? _____
 - b) You do a "Sterling-dollar" trade for cash. What date will it settle? _____
 - c) You do a "Dollar-CAD" trade. What date will it settle? _____

4. You have just become the new Yen trader at Lehman Brothers. The old Yen trader left for Monaco with a square position. You do the following:
 - a) Citi calls for a JPY quote. You quote 123.97/124.00. Citi buys USD 5MM.
 1. At what rate is the deal done? _____
 2. What is your position in JPY? _____

3. What is your position in USD? _____
- b) You know that the dollar is going higher. Another bank quotes you 124.10/124.25.
1. Is the dollar higher? _____
2. What trade would you do? _____
3. What are your positions now? _____
4. What is your profit/loss? _____

ANSWERS

1. As a dealer, you transact at the following rates:

Buy GBP / sell USD: 1.5475
 Sell CHF / buy USD: 1.5025
 Buy JPY / sell USD: 125.20
 Sell NZD / buy USD: 0.4837

2.

	Bid	Offer
GBP/CHF	2.3266	2.3274
NZD/JPY	60.42	60.56
GBP/NZD	0.3117	0.3126

3. a) October 24, 2002
 b) October 22, 2002
 c) October 23, 2002
4. a) 1. Deal is done at the offer of 124.00
 2. You are long ¥ 620,000,000.
 3. You are short 5MM dollars.
- b) 1. Yes
 2. Buy 5 dollars.
 3. You are square dollars, short ¥ 1,250,000.
 4. \$10,073 loss

FOREIGN EXCHANGE FORWARDS

INTRODUCTION

FX FORWARDS

AN INTRODUCTION TO FOREIGN EXCHANGE FORWARDS

INTRODUCTION

Investors in currencies have diverse needs and interests in the market. Much of those needs are met in the spot market, where a significant volume (about \$600 billion per day) occurs. But, a significant portion of the market (around 60% or \$900 billion per day) needs currency trades that mature past the spot date. Forward transactions are defined by a settlement date beyond the standard two-day spot settlement. Forward settlement can range anywhere from 3 days to three years.

WHAT ARE FORWARDS?

- Forwards are an agreement between two counterparties to exchange currencies at a pre-determined rate on some future date.
- Since any foreign exchange transaction automatically involves two currencies, two interest rates are necessary, the dominant interest rate and the secondary interest rate. Examples of the dominant /secondary interest rates would include EUR vs. USD or USD vs. JPY.
- Forwards can include outright and swaps.
- An outright is a spot transaction for a future date (past the spot date). It is a derivative product consisting of a spot transaction combined with a forward spread. The spot portion of the transaction is more volatile than the forward portion, so most of the price action will occur in that portion of the outright.
- A swap is a simultaneous buying and selling of the same currency with a counterparty with each leg maturing on a different date. The near leg of a swap can be either for spot settlement (a traditional swap) or for forward settlement (a forward/forward). A swap is a combination of a spot deal and a forward outright.
- To arrive at a forward rate at which to deal, forward points are applied to the spot rate. Forward points may be either positive or negative, and are a function of the interest rate differential between the two currencies in which you are dealing and the maturity of the trade. Forward points do not represent an expectation of the direction of a currency, but rather the interest rate differential.

CALCULATING THE FORWARD RATE

In the first section, we discussed outright exchanges of one currency for another for spot settlement. Now we will focus on the pricing of outright exchanges for forward dates, or dates other than spot.

The rate of exchange for any date other than spot is a function of *spot* and the *relative interest rates* in each currency, because the assumption is that any funds you have will be invested in a time deposit of that currency. *The forward rate is the rate which neutralizes the effect of differences in the Eurocurrency interest rates.* If this were not the case, investors and speculators would always buy and invest in the high interest rate currency, eliminating their exchange rate risk with the forward contract. An example will illustrate this.

Assume you are a dollar-based investor who has \$1,000,000 to invest for one year in Sterling-denominated stock. Your investment parameters do not permit you to be exposed to exchange rate risk, so you must set the rate at which you will re-convert the Sterling into dollars at the time you enter into the investment. There is a 3% interest rate differential between the dollar and Sterling market, since you can earn 2% if you invest in the Eurodollar market for the year or 5% if you invest in Euro Sterling. In an arbitrage-free market, the forward rate will eliminate the 3% interest rate differential between the dollar and Sterling. To determine what forward rate would eliminate the benefit of being invested in Sterling:

1. determine how much you would earn if you invested in dollars;
2. buy one million dollars' worth of GBP spot against the dollar (currently 1.55 \$/£)
3. determine how many pounds you will have at the end of the investment period; and
4. determine what forward exchange rate will convert your pound return into a dollar amount equal to what you would have earned had you invested in dollars.

$$\blacksquare \quad \$1,000,000.00 \quad \times \quad 1.020277778^1 = \$1,020,277.78$$

$$\blacksquare \quad \$1,000,000 \quad / \quad 1.55 \quad = \text{£}645,161.29$$

$$\blacksquare \quad \text{£}645,161.29 \quad \times \quad 1.05^{11} \quad = \text{£}677,419.35$$

$$\blacksquare \quad \text{The rate which equates these two cash flows is } 1.4762 \text{ \$}/\text{£}$$

$\$1,020,277.78 = X * \text{£}677,419.35$

- $X = \$1,020,277.78 / \text{£}677,419.35$
- $X = \$1.5061$

¹ Use exact days over the correct day-count convention (360-day year for most currencies except Sterling which uses a 365-day year): [$\$1,000,000 * (1 + 0.02 * (365/360))$] and [$\text{£}667,419.35 * (1 + .05 * 365/365)$].

By buying £ at 1.5500 and selling it at the forward rate of 1.5061, the benefit of the 3 % interest rate differential is completely eliminated. At a forward rate of 1.5061 \$/£, you would be totally indifferent as to which currency you invest in. This rate is also the equilibrium rate between the spot and forward markets; at 1.5061 \$/£, you would be no better off if you bought the currency forward or if you bought the currency spot today and invested it for the year before you needed it.

We now know that 1.5061 is the equilibrium forward rate. At any other rate, there is an arbitrage opportunity between the forward market and the Eurocurrency market. If the rate were higher, say 1.53, you could arbitrage (take advantage of) the discrepancy between the FX market and the time deposit market. To do so, you would buy £ spot today @ 1.55, invest in a Sterling time deposit for the year at 5%, and then sell the £ (repatriate the dollars) at the pre-agreed forward rate of 1.53. Since you sell £ at the higher exchange rate of 1.53, the forward rate does not totally eliminate the interest rate differential and you would come out ahead. Since these are highly liquid, closely watched markets, arbitrage is extremely rare.

It is important to note that the forward rate reflects the current interest rate, and it assumes that you invest at that rate. If the interest rate differential changes between the time you do the forward and the time you invest your funds, you would experience a gain or a loss. For example, assume you do a forward in Canadian dollars with a 1% interest rate differential priced into the contract. The instant after you do the forward, the Canadian rate drops 10 basis points. Now you will have fewer CAD at the end of one year than you “should” have, so you will experience a loss vis-à-vis what you would have earned had you remained in dollars. *If you do not earn the interest rate differential implied in the forward rate, you will experience a loss or a gain.*

In the swaps section of this workbook we will review hedging, arbitrage, and how to position yourself at current rates in order to “bet” on a relative move in interest rates.

Rather than using the aforementioned cash flow analysis technique, it is more common to think of the forward rate in terms of how much it differs from the spot rate. Normally, you will know the spot rate and the forward points (discussed momentarily), and given these two pieces of information you can derive the forward rate. The difference between the forward rate and spot is referred to as forward points.

	Spot		Forward Points		Forward Rate
GBP:	1.5500	-	0.0439	=	1.5061
JPY:	122.50	-	0.2287	=	122.2713
AUD:	0.5575	-	0.0048	=	0.5527

The difference between the spot and the forward rate is the forward points. In the example we have just seen:

	Spot		Forward Rate		Forward Points
GBP:	1.5500	-	1.5061	=	0.0439
JPY:	122.50	-	122.2713	=	0.2287
AUD:	0.5575	-	0.5527	=	0.0048

The forward rate neutralizes the interest rate differential, making you indifferent as to whether you buy a currency spot or forward.

Although you are normally given forward points, it is a useful exercise to know how to calculate them.

HOW DO YOU CALCULATE FORWARD POINTS?

$$\text{Forward Points} = S * (E2 - E1) * (T/360) * 100$$

S = Spot Rate
 E1 = Dominant Interest Rate
 E2 = Secondary Interest Rate
 T = Number of Days to Maturity

- *Example:*
- What are the 1 year Forward Points for EUR/USD?

Spot = 1.0110
 1 YR EUR Interest rate = 2.97
 1 YR USD Interest rate = 1.52
 T = 365

$$\text{Points} = 1.0110 * (1.52 - 2.97) * (365/360) * 100$$

1-Year EUR/USD is -148.6

PAY AND EARN POINTS

Remember, the forward rate neutralizes the interest rate differential, making you indifferent as to whether you buy or sell a currency spot or forward.

- If you benefit from the differential by having an interest-bearing deposit in the higher interest rate currency from the period between today and the forward date, you will pay for it in the forward points.
- If you do not benefit from the differential, you will earn the forward points.

Since the information you normally have is spot and the forward points not the forward rate, you must decide (a) whether you should pay or earn the points and (b) whether to add or subtract the points to get the forward rate. Let's see how this works in the following examples:

Let's say that you—the client—want to buy GBP forward against the USD. We will assume that when you buy Sterling forward against dollars, you will have a dollar deposit for the period from today to the forward date. In our example, dollar interest rates are lower than Sterling interest rates, so you will *not* earn the differential during that period. Therefore, you will earn the forward points. In the case of Sterling, that means you will buy the £ at a lower, more advantageous rate (that is, pay fewer dollars per pound) in the future, so you subtract the points to get the rate. The points are 439 points:

LEHMAN BROTHERS		Date	3/18/03		Memo
Bank/Customer Account					
<i>Client XYZ</i>					
Broker Rate	WE (+)	Customer Rate	WE (-)	Value Date	
		1.5500			
Broker Rate	WE (+)	Points	WE (-)	Value Date	
		-0439			
15,061,000 USD		Rate	10 GBP		9/20/04
☐ ORDER ☐ LINK		C R O S S	☐ EFP _____ ☐ TY _____ TYPE		
			☐ CROSS _____ ☐ TN _____ TYPE & NO COMMISS		
			☐ NC _____ NO COMMISS		
			☐ DN _____ GELY - NO COMMISS		
Dealer	Region	Mark Up	Sales Credit		
LBF 8197 (4/94)		TRADING DESK		Foreign Exchange Trading/Sales	

$$1.5500 - 0.0439 = 1.5061 \text{ \$/£}$$

Again, in the case of buying yen forward against the dollar, you will have a dollar deposit for the period preceding the forward date. But, since dollar interest rates are higher than yen interest rates in our example, you will earn the interest rate differential so you must pay the points. This means you will sell the \$ at a lower, less advantageous rate (that is, get fewer yen per dollar) in the future, so you subtract the points to get the forward rate. The points are 22.87 points:

LEHMAN BROTHERS		Date	3/18/03		Memo
Bank/Customer Account					
Client XYZ					
Broker Rate	WE (+)	Customer Rate	WE (-)	Value Date	
		122.50			
Broker Rate	WE (+)	Points	WE (-)	Value Date	
		-0.2287			
8,178,534.13		Rate	122.2713	1,000,000,000 JPY	05/19/03
☐ ORDER ☐ LINK		C R O S S	☐ EFF		☐ TY TYPE
			☐ CROSS		☐ TN TYPE & NO COMMISS.
			☐ NC NO COMMISS.		☐ RO ROLLOVER
			☐ DN DELY + NO COMMISS.		☐ DL DELIVERY
Dealer	Region	Mark Up	Sales Credit		
LBF 8107 (4/94)		TRADING DESK		Foreign Exchange Trading/Sales	

$$122.50 - 0.2287 = 122.2713 \text{ \$/¥}$$

Finally, in the case of selling Aussie forward against the dollar, you will have a AUD deposit for the period preceding the forward date. Since the AUD deposit rate is higher than the dollar one, you will earn the differential, so you must pay the points. This means that you will buy \$ at a higher, less advantageous rate (that is, it will take more AUD to buy one dollar) in the future, so you subtract the points. The points are 48 points:

LEHMAN BROTHERS		Date	3/18/03		Memo
Bank/Customer Account					
Client XYZ					
Broker Rate	WE (+)	Customer Rate	WE (-)	Value Date	
		0.5575			
Broker Rate	WE (+)	Points	WE (-)	Value Date	
		-0.0048			
10 AUD		Rate	0.5527	5,527,000	06/19/03
☐ ORDER ☐ LINK		C R O S S	☐ EFF		☐ TY TYPE
			☐ CROSS		☐ TN TYPE & NO COMMISS.
			☐ NC NO COMMISS.		☐ RO ROLLOVER
			☐ DN DELY + NO COMMISS.		☐ DL DELIVERY
Dealer	Region	Mark Up	Sales Credit		
LBF 8107 (4/94)		TRADING DESK		Foreign Exchange Trading/Sales	

$$0.5575 - 0.0048 = 0.5527 \text{ \$/AUD}$$

Notice that for GBP, 439 points translated to 0.0439 and for JPY, 22.87 points translated to 0.2287. This is because forward points are quoted in *pips*. A pip is the last decimal point in a price. For currencies such as the GBP which is quoted out to four decimal places, a pip is equal to 0.0001. Yet for currencies such as the JPY which is quoted out to two decimal places, a pip is equal to 0.01. Therefore, 439 points for the GBP is equal to $439 * 0.0001 = 0.0439$, and 22.87 points for the JPY is equal to $22.87 * 0.01$.

SUMMARY

In summary, the forward rate of exchange is the vehicle for adjusting for the interest rate differential. If you theoretically earn more in one currency than the other due to the interest rate differential, the forward exchange rate will exactly offset this gain. The interest rate differential, adjusted for time, determines the forward points. The forward points reflect only today's difference in interest rates; they are *not* an indication of what the future spot or interest rates will be.

SAMPLE PROBLEMS

Given the information below,

- (a) Calculate the forward points and the forward rate and
- (b) State whether you would earn or pay the points.

1. You, the client, wish to sell CAD forward one year against the USD.

Euro USD rates = 5.0 %

Euro CAD rates = 7.0 %

Spot = 1.45 CAD/USD

Forward points =

Forward rate =

Pay or earn points =

2. You wish to buy CHF forward one year against the USD.

Euro USD rates = 5.0%

Euro CHF rates = 4.0 %

Spot = 1.52 USD/CHF

Forward points =

Forward rate =

Pay or earn points =

ANSWERS

1. Forward points = 0.0294

Forward rate = 1.4794

Since you earned the interest rate differential, you will have to pay the points by paying more CAD per USD in the future.

Points = $1.4500 * (7.0 - 5.0) * (365/360) * 100$

Points = +294 points

$$1.4500 + 0.0294 = 1.4794$$

LEHMAN BROTHERS		Date	3/18/03		Memo
Bank/Customer Account					
Client XYZ					
Broker Rate	WE (+)	Customer Rate	WE (-)	Value Date	
		1.4500			
Broker Rate	WE (+)	Points	WE (-)	Value Date	
		+0.0294			
	10 CAD	Rate			
		1.4794		6,759,497.09 USD	
☐ ORDER		☐ LINK			
Dealer	Region	Mark Up	Sales Credit		
		CROSS	☐ EFP ☐ CROSS ☐ NC NO COMMISS ☐ DN DELY + NO COMMISS		
			☐ TY TYPE ☐ TN TYPE + NO COMMISS ☐ RO ROLLOVER ☐ DL DELIVERY ☐ N NO SALES CREDIT		
LBF 8187 (4/94)		TRADING DESK		Foreign Exchange Trading/Sales	

2. Forward points = -0.0154

Forward rate = 1.5046

Since you earned the interest rate differential, you will pay the forward points by receiving fewer CHF at the forward rate.

Points = $1.5200 * (4.0 - 5.0) * (365/360) * 100$

Points = -154 points

$$1.5200 - 0.0154 = 1.5046$$

LEHMAN BROTHERS		Date	3/18/03		Memo
Bank/Customer Account					
Client XYZ					
Broker Rate	WE (+)	Customer Rate	WE (-)	Value Date	
		1.5200			
Broker Rate	WE (+)	Points -0.0154	WE (-)	Value Date	
		Rate 1.5046			
6,646,284.73USD		10 CHF		06/21/04	
☐ ORDER ☐ LINK		C R O S S	☐ EFP ☐ TY TYPE ☐ CROSS ☐ TN TYPE & NO COMMISS. ☐ NC NO COMMISS. ☐ RO ROLLOVER ☐ DN DELY + NO COMMISS. ☐ DL DELIVERY ☐ N NO SALES CREDIT		
Dealer	Region		Mark Up	Sales Credit	
LBF 6107 (4/94)		TRADING DESK		Foreign Exchange Trading/Sales	

PREMIUM VS. DISCOUNT POINTS

Premium Points occur when the minor currency interest rate is higher than the dominant currency interest rate.

Examples: USD/CAD, USD/SEK, USD/NOK, USD/ZAR

- The bid will always be quoted lower than the offer
- 1 Year USD/CAD is quoted 215/220
- These points will be added to the spot rate:

$1.5690 + 0.0215 = 1.5905$

- As the interest differential widens, points will move to the “right” (i.e. become more positive)

Discount Points occur when the minor currency interest rate is lower than the dominate currency interest rate.

Examples: USD/JPY, EUR/USD, GBP/USD, USD/CHF

- The bid will always be quoted higher than the offer
- 1 Year EUR/USD is quoted 149/148
- These points will be subtracted from the spot rate:

$1.0130 - 0.0149 = 0.9981$

- As the interest differential widens, the points will move to the “left” (i.e. become more negative)

SAMPLE PROBLEMS

Given the information below, determine (a) if you would pay or earn the points and (b) what the forward rate would be.

Currency	Spot	Interest Rate
USD		5.00%
GBP	1.6 GBP/USD	4.50 %
EUR	0.9900 EUR/USD	5.50 %
JPY	120.00 USD/JPY	4.75 %

1. You want to buy Sterling forward against the dollar. The forward points are 0.0542.
2. You want to sell Euro forward against the dollar. The forward points are 0.0756.
3. You want to buy Yen forward against the dollar. The forward points are 1.05.

ANSWERS

1. Pay the points; forward rate = 1.6542 \$/£

Since you are staying in a high interest rate currency, you will have to pay the points. Since you are paying more dollars per pound in the future than you would today, you have paid the points.
2. Pay the points.; forward rate = 0.9144 EUR/\$

▪ By selling the Euros forward, you have remained in the high interest rate currency. Since you earned the interest rate differential, you will pay the points by paying fewer \$ per Euro in the future than you would today.
3. Pay the points; forward rate = 121.05 \$/¥

▪ By buying Yen forward, you have stayed in the high interest rate currency, so you will not earn the interest rate differential. You will receive fewer Yen per dollar at the forward rate than you would at the spot rate.

FORWARD DATE CONVENTIONS

Trading date conventions are the same as they are in the Eurocurrency market, and they dictate what the exact straight dates are. Dealing for proper value dates is imperative. Not accounting for interest rate differentials, even for a few days, can be an unnecessary expense. These conventions are:

- *Date-to-date:* The market trades date-to-date, which means that the appropriate date for each of the forward periods is the date corresponding to the spot date being traded on a given day. If the spot value date were July 6th, the forward date for each of the regular forward periods would be the sixth of the appropriate month unless the sixth were a holiday or a weekend. For example, the one month forward date would be August 6th, the two month forward date would be September 6th and so on.
- *It is key to note that not all months have thirty days. Always count the number of days for each forward period or use a trader's calendar.*
- *Holidays/Weekends:* If the forward date is a holiday or a weekend in either of the centers concerned, the value date moves to the next business day. Since January 6th is a Sunday, the six-month forward date would be July 7th.
- *End-to-end:* If the spot date is the last business day of the month, the forward value date for each month must be the last business day of the appropriate month. Assuming spot were November 30, 2002, the last business day of the month, the forward value dates would be December 31st, January 31st, February 28th, May 31st, and November 29th—all the last days of the month.
- *When market-makers deal with clients, they will do the forward for any number of days the client wishes; that is, they will do odd-dated forwards. They will also do odd-dates with other dealers with whom they deal regularly, but it is more common to trade straight dates. Straight dates are limited to spot against one month, two months, three months, six months, nine months, and twelve months.*

Using the calendar on the following page, answer these questions. Assume today is Wednesday, July 3rd. However, the calendar is opened to July 8th, since traders open their calendars to the spot date (2 business days after the trade date).

1. What is the two-month forward date?
2. What is the one-month forward date?
3. If spot were July 31st, what would the two-month forward date be?

SOURCE: EUROMARKET DAY FINDER, COPP CLARK LIMITED & R.H. LAVERS

ANSWERS

1. Monday, September 9th
2. August 8th
3. September 30th (following the end-to-end rule)

CALCULATING ODD DATES

Client wants to B/S EUR for value May 29, 2003

May 29 = 197 days
 6-months = 181 days = -83.2 bid
 7-months = 212 days = -95.5 bid

- We must calculate the average forward points between 6 months and 7 months and then adjust the points by interpolation for the number of days in the odd date.

$$(83.2 - 95.5) * (197\text{days} - 181\text{ days}) / (212\text{ days} - 181\text{ days}) = -6.35$$

Take -6.35 + -83.2 and the price is -89.55

Using the Forward Pricer is much easier.

Forward Pricer (Paradis)													
JPY		CAD		AUD		CHF		NOK		HKD		ZAR	
GBP		EUR		NZD		SEK		DKK		SGD			
NY	EUR	USD	Home Cur		11/13/2002				1.0109 / 1.0110				
Paradis Account		T4528		Source		Manual		Turns		Save			
Last Update: 11/11/02 12:28:04 EST						Revert		Print		Detach		Multi	
T4528	T4528	Bid Spr	Ask Spr	Choice	Tenor	Date	Days	Eff Bid	Eff Ask				
0.00	0.00	0.00	0.00	T4528	ON	11/12/02	0	0.00	0.00				
-0.555	-0.55	0.00	0.00	T4528	TN	11/13/02	-1	-0.555	-0.55				
-0.56	-0.55	0.00	0.00	T4528	SN	11/14/02	1	-0.56	-0.55				
-3.88	-3.86	0.00	0.00	T4528	1W	11/20/02	7	-3.88	-3.86				
-7.75	-7.68	0.00	0.00	T4528	2W	11/27/02	14	-7.75	-7.68				
-11.58	-11.48	0.00	0.00	T4528	3W	12/04/02	21	-11.58	-11.48				
-16.50	-16.40	0.00	0.00	T4528	1M	12/13/02	30	-16.50	-16.40				
		0.00	0.00	Interpolated	IMM1	12/18/02	35	-18.90	-18.79				
-31.40	-31.20	0.00	0.00	T4528	2M	01/13/03	61	-31.40	-31.20				
-45.70	-45.50	0.00	0.00	T4528	3M	02/13/03	92	-45.70	-45.50				
-57.90	-57.50	0.00	0.00	T4528	4M	03/13/03	120	-57.90	-57.50				
		0.00	0.00	Interpolated	IMM2	03/19/03	126	-60.45	-60.03				
-71.50	-71.00	0.00	0.00	T4528	5M	04/14/03	152	-71.50	-71.00				
-83.20	-82.70	0.00	0.00	T4528	6M	05/13/03	181	-83.20	-82.70				
-95.50	-94.50	0.00	0.00	T4528	7M	06/13/03	212	-95.50	-94.50				
		0.00	0.00	Interpolated	IMM3	06/18/03	217	-97.31	-96.31				
-106.75	-105.75	0.00	0.00	T4528	8M	07/14/03	243	-106.75	-105.75				
-117.25	-116.25	0.00	0.00	T4528	9M	08/13/03	273	-117.25	-116.25				
-128.00	-127.00	0.00	0.00	T4528	10M	09/15/03	306	-128.00	-127.00				
		0.00	0.00	Interpolated	IMM4	09/17/03	308	-128.62	-127.62				
-137.00	-136.00	0.00	0.00	T4528	11M	10/14/03	335	-137.00	-136.00				
-146.00	-145.00	0.00	0.00	T4528	12M	11/13/03	365	-146.00	-145.00				
Fwd/Fwd		Multiple Dates		Cross Calc		Cross Details		Inverted					
Date		Days		Bid		Ask		Outright Bid		Outright Ask			
05/29/03		197		-89.55		-88.79		1.001945		1.002121			
Java Applet Window													

TYPES OF TRANSACTIONS

- **Outright** This deal is essentially a spot deal for value some date in the future

Spot EUR/USD is 1.0125/30
1 year EUR/USD is 149/148

If a client wants to buy 1 year EUR/USD outright, the price would be calculated as:

$1.0130 - 0.0148 = 0.9982$

- **Swap** This is a transaction where the client simultaneously buys and sells (or vice versa) an even amount of currency for two different value dates with the same counter party. Some clients may do swaps because they have foreign currency receivables collected in advance of their payables, and want to make use of the non-foreign currency equivalent in the meantime. They may be used to hedge interest rate risk. Or, some clients may not want to take delivery of a particular currency. So, if they are due to receive, say JPY, on a certain date, they may Sell JPY for spot and buy it forward, giving them the ability to lock in profits at that level.

Example: SELL 50 EUR for spot at 1.0010
 BUY 50 EUR for value date 1 year at 0.9865

HOW DO THE FORWARD POINTS CHANGE?

- The interest rate differential changes based on the movement in the interest rate futures markets
- As the market's expectations of where interest rates are going to be in the future change, the forward points will change accordingly
- Since spot is also a variable in the forward point formula, any change in the spot rate will also change the forward points

WHICH SIDE OF THE MARKET?

To determine which side of the market to deal on, always look at what is happening on the forward leg, or far leg of the trade.

Example:

1 Year EUR/USD is trading at 146/145.

Client wants to trade a swap where they Sell and Buy EUR/USD for 1 year.

The screenshot shows a financial terminal window with the following content:

```

/11 19:02 GMT [TRADITION - NY] 11/11 12:28 4528
[EUR/USD FORWARDS - DEALING PRICES]
SHORT DATES FORWARD RATES IMM DATES
xxxxx/xxxxx x 1MO -16.50/-16.40 x Dec -18.85/-18.70 x
-0.555/-0.55 x 2MO -31.40/-31.20 x Mar -60.50/-60.00 x
-0.56/-0.55 x 3MO -45.70/-45.50 x Jun -97.25/-96.25 x
-3.88/-3.86 x 4MO -57.90/-57.50 x Sep-128.75/-127.75 x
-7.75/-7.68 x 5MO -71.50/-71.00 x
-11.58/-11.48 x 6MO -83.20/-82.70 x
/ x 7MO -95.50/-94.50 x
DATES ] 8MO -106.75/-105.75 x
9MO -117.25/-116.25 x
10M -128.00/-127.00 x
11M -137.00/-136.00 x
12M -146.00/-145.00 x
15M -171/-167 x
18M -190/-186 x
2YR -219/-213 x
3YR -265/-245 x
4YR -305/-275 x
5YR -340/-300 x
  
```

At the bottom of the terminal window, there is a status bar with the text: "For Help, press F1" and "Work space 'tab7.wsp' restored".

- Client is buying EUR/USD forward, so they would “take the offer” or “deal on the RHS” at -145

The ticket for this trade would look like this:

LEHMAN BROTHERS				Date	11/01/02	Memo
Bank/Customer Account						
Client XYZ						
Broker Rate	WE (+)	10 €	Customer Rate	WE (-)	10,010,000 USD	Value Date 11/11/02
Broker Rate	WE (+)	9,865,000 USD	Points -0.0145 Rate 0.9865	WE (-)	10 EUR	Value Date 11/13/03
☐ ORDER		☐ LINK				
Dealer	Region	Mark Up	Sales Credit			
				C R O S S		
				☐ EFP ☐ CROSS ☐ NC NO COMMISS. ☐ DN DELY + NO COMMISS.		
				☐ TY TYPE ☐ TN TYPE & NO COMMISS. ☐ RO ROLLOVER ☐ DL DELIVERY ☐ N NO SALES CREDIT		
LDF 0107 (4/96)				TRADING DESK Foreign Exchange Trading/Sales		

CURRENCY FUTURES

- Currency futures are specific types of outright deals. They are traded on regulated exchanges (IMM, FINEX) with fixed amounts and maturity dates
- Standard settlements are on the third Wed. of every third month (March, June, September, December)
- There is no individual counter party risk. The exchange is responsible for clearing all trades

$$\text{CURRENCY FUTURE PRICE} = (1 / \text{outright price for maturity date})$$

- EFP's (*Exchange for Physical*) - a special trade consisting of a spot deal executed in the cash market and the outright "posted" as a future contract on the exchange.

FUNDING

- The forward desk serves as the funding arm for the firm's currency balances.
 - Every day the forward desk pools all of the firm's currency balances to come up with one net position.
 - The forwards desk must make these positions flat at the end of each day in order to ensure the proper payments are made.
 - The forwards desk funds positions through the use of Tomorrow/Next, or T/N, swaps.
 - Clients may also "roll" their positions with the forward desk to any date in the future

TRADE IDEAS AND HOW THEY ARE FORMED

- Trade ideas are formed by a series of analytical techniques. They are presented here merely as a list, but a more detailed analysis is available by asking your friendly forwards' trader.
- Many trade ideas are based on simple fundamentals
 - Interest rates exhibit trend patterns better than currencies, allowing one to generate ideas about interest rates and their probable future direction. Trade ideas are more useful in interest rates also because their movements aren't as volatile as those of spot.
 - Forming trade ideas is more about taking a medium term (vice short-term) view.
- Many trade ideas are based on technical analysis.
- Traders utilize multiple products to implement their ideas. These may include futures, swaps, and FRA's.
- Trade ideas are influenced by the carry or points per day available by remaining in a high-yielding currency. This concept is explained further later in this chapter.

Most of our positions are taken through swaps:

- We will execute positions from either and over-borrowed or over-lent vantage.

- *Example:* One year JPY is trading at 206/204

Buy \$10 USD, sell JPY for value spot @
124.50
Sell \$10 USD, buy JPY for value one year
@ 122.44

- We are looking for the interest rate differential between USD and JPY to widen.
- Specifically, we are looking for higher US rates because we are borrowing dollars today and then lending them out in the future
- We are entering into an even swap, which creates a spot equivalent position
 - We buy JPY at 124.50 and sell JPY at 122.44, a 1.7% difference
 - Present value of \$10 1 year out @ 1.7% is \$9.35
 - $\$10 - \$9.35 = +\$650,000$ (long) spot equivalent
 - Normally, we hedge this position by selling USD/JPY

TRADING EURODOLLAR FUTURES

- Eurodollar Futures are three-month futures
- They expire every 3rd Wednesday of every 3rd month
- Sample Eurodollar prices:

Dec 02 98.58
Mar 03 98.53

JUN03 98.26

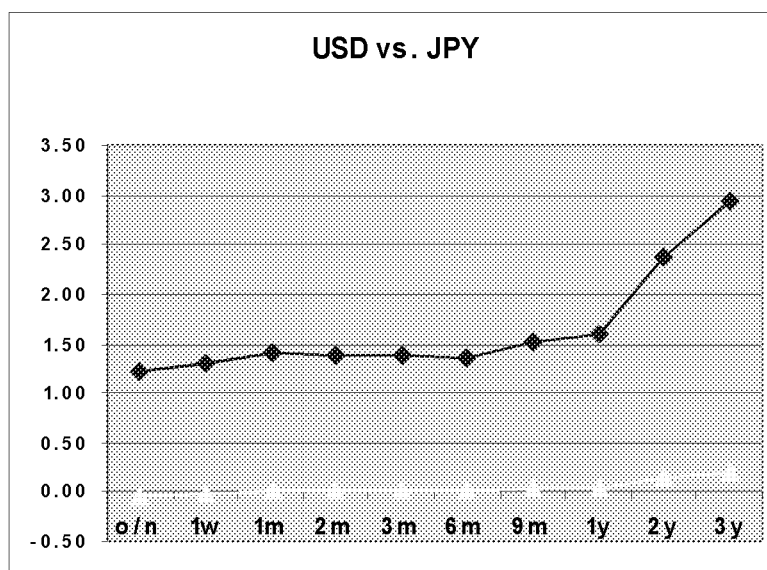
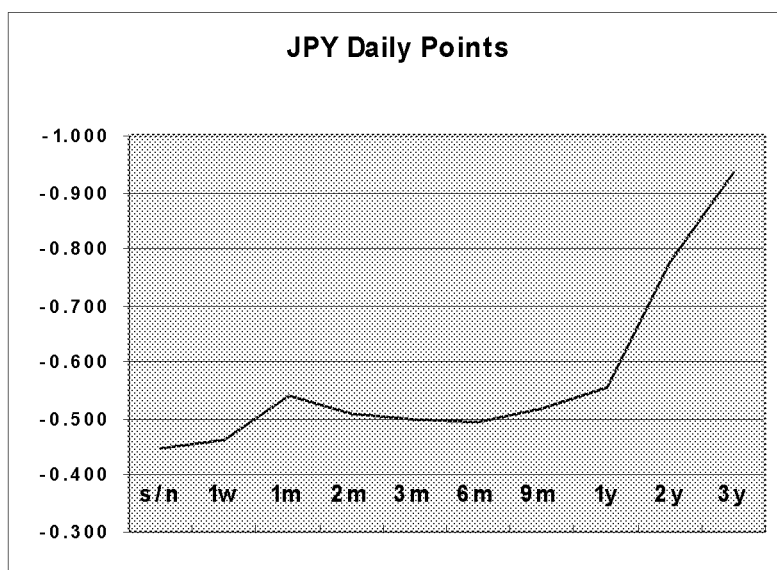
Sep 03 97.89
Dec 03 97.46

- *Example:* Jun 03 contract implies that 3 month rates are expected to be $100 - 98.26 = 1.74\%$ at that time vs. cash today at 1.42
- Typically, 3 month rates are 10-12 bps over fed funds, so fed funds expectation in June 03 is 1.6 – 1.62 (assuming a normal rate environment)

11:45 Quote Board PD42								
	TUAAH3	EDAAZ2	QNAZ2	QEAZ2	QSAZ2	EYZ2	ZYZ2	BXZ2
O	106107	98577	99260	97080	95970	99915	99915	97165
H	106137	98585	99280	97095	96000	99915	99915	97170
L	106107	98572	99260	97070	95960	99915	99915	97150
L	106125 ^A	98577 ^B	99280 ^A	97075 ^B	95980 ^B	99915	99915 [✓]	97155 ^A
Δ	+12	-2	+20	0	+20	0	-5	-5
	FVAH3	EDAAH3	QNAH3	QEAH3	QSAH3	EYH3	ZYH3	BXH3
O	110060	98505	99180	97160	95900		99870	97160
H	110170	98530	99240	97190	95970	99870	99875	97160
L	110045	98495	99180	97140	95880		99865	97110
L	110125 ^A	98520 ^A	99220 ^B	97165 ^B	95950 ^A	99875 ^A	99875 [✓]	97140 ^A
Δ	+30	+15	+40	+10	+40	+5	0	0
	TYAH3	EDAAH3	QNAH3	QEAH3	QSAH3	EYH3	ZYH3	BXH3
O	110240	98240	98990	97105	95720	99890	99885	96680
H	111110	98275	99060	97155	95810	99890	99890	96690
L	110240	98215	98990	97085	95690	99890	99885	96640
L	111040	98255 ^A	99050 ^A	97130 ^A	95770 ^B	99890	99890 [✓]	96680 ^A
Δ	+45	+15	+50	+25	+40	0	0	+20
	USAH3	EDAAU3	QNAU3	QEAU3	QSAU3	EYU3	ZYU3	BXU3
O	10725	97855	98790	96970	95520	99875	99875	96600
H	10824	97940	98860	97045	95620	99880	99875	96620
L	10724	97820	98790	96950	95500	99875	99875	96560
L	10843	97880 ^A	98840 ^B	97020 ^A	95580 ^A	99875	99875 [✓]	96580 ^B
Δ	+10	+25	+50	+50	+50	-5	-5	-10
		EDAAZ3	QNAZ3	QEAZ3	QSAZ3	EYZ3	ZYZ3	BXZ3
O		97425	98540	96770	95320		99850	96370
H		97485	98560	96850	95420		99850	96400
L		97400	98540	96755	95310		99850	96340
L		97455 ^A	98550 ^B	96830 ^A	95360 ^B	99855 ^A	99850 [✓]	96360 ^A
Δ		+30	+40	+55	+30	+5	-5	+30

TRADING SPREADS INVOLVES ANALYZING YIELD CURVES

- Expectations of changes in the yield curve can help form views on new positions



EXAMPLE OF A POSITIVE CARRY TRADE

■ USD/JPY

Spot/Next Points: -0.45 3-Year Points: -1040 or (-0.95 per day)
--

- Trade:* Sell/Buy \$10 USD/JPY three years out into the future. This leaves us short USD and long JPY until the far leg of the trade.
- Carry:* Each day, we fund our short USD position at 0.45 per day, and earn 0.95 per day on forward leg. This is a positive net carry of 0.5 per day.
- Analysis:* To determine the positive carry: $10\text{USD} * [0.005 / 120.00 \text{ (spot rate)}] = \$417/\text{day}$
- Position:* Here, we are overlent USD and thus benefit from rates going down. Therefore we are looking for rates to move lower.
- Evaluation:* If the bid/ask spread on the three-year is 20 points, we would pay \$16,000 ($0.0020 * \$10,000,000$). At a positive carry per day of 0.5, we would need 40 days ($20 \text{ days} / 0.5$) of steady rates or rates moving in our favor in order to break even. Points moving in our favor would effectively shrink or eliminate the large bid-ask spread.

FORWARDS REVIEW PROBLEMS

	EURO	AUD	NZD	JPY	GBP	CAD
Spot	0.9957	0.55885	0.4982	124.64	1.56865	1.5557
1 mo	13.9/13.8	16.2/16	19/18.7	17.3/17.2	33.4/33.3	18.8/19.2
2 mo	27.3/27.1	32.4/32.1	38.5/38.1	31.8/31.5	67.65/67.35	37.5/37.8
3 mo	39.1/38.9	46.8/46.4	54.9/54.4	45.3/44.9	98.5/98.2	55/56
6 mo	75/74/7	92.3/91.8	109/108	91/90	198.5/197.5	111/113
1 yr	129.25/128.25	174.8/173.8	207/204	204/202	384/381	214/218

******Remember, if the bid is greater than the offer, this implies that points are discount, not premium points******

1) For the following customer orders, determine which side would be dealt on and what the forward rate would be. Use the above spot rates and forward points.

Customer wants to:

- a) Sell/buy EUR 3 months out
 - b) Sell/buy JPY 6 months out
 - c) Buy/sell CAD 1 year out
 - d) Buy/sell USD vs. NZD 1 month out
 - e) Sell/buy USD vs CAD 2 months out
 - f) Buy/sell USD vs AUD 1 year out
 - g) Sell/buy JPY 6 months out
 - h) Sell/buy USD vs Eur 2 months out
- 2) If the forward desk buys and sells \$10 USD/JPY 1 year forward, will the desk have a long or short spot equivalent position? Why?
- 3) If Sep 03 Eurodollar futures are trading at 97.93, what is the expectation for 3 month rates at that time? Overnight rates?
- 4) If we have an expectation for EUR rates to go down and/or US rates to go up, what position should we take using swaps to try and capitalize on this?
- 5) If we have an expectation for CAD rates to go down and/or US rates to go up, what position should we take using swaps to try and capitalize on this?
- 6) If we sell and buy GBP 3 months out, what is our expectation for GBP vs US rates?

ANSWERS

1.
 - a) Buy EUR in the future means RHS, so forward price is $.9957 - .00389 = .99181$
 - b) Sell USD in the future means LHS, $124.64 - .91 = 123.73$
 - c) Buy USD in the future means RHS, $1.5557 + .0218 = 1.5775$
 - d) Buy NZD in the future means RHS, $.4982 - .00187 = .49633$
 - e) Buy AUD in the future means RHS, $1.5557 + .00378 = 1.55948$
 - f) Buy AUD in the future means RHS, $.55885 - .01738 = .54147$
 - g) same as b, sorry!
 - h) Sell EUR in the future means LHS, $.9957 - .00273 = .99297$
2. We are buying USD/JPY for value spot and selling USD/JPY for value one year forward. Since the present value of our short position is less than the present value of the current long spot position, we have a net long spot equivalent position.
3. $100 - 97.93 = 2.07$, expected 3 month rates. Since we said that 3 month rates are typically 10 – 12 points above overnight rates, we would say that the market expects overnight rates to be approximately 1.95 – 1.97 in September 2003.
4. We would over lend, or sell and buy Euros to match this view. Effectively, we would be borrowing Euros at the future date, so it makes sense that we would be looking for lower rates. On the other side, we are effectively lending out USD in the future, so we would be looking for an increase in USD rates.
5. Buy and sell USD, sell and buy CAD for the same reasons as above. The tricky part here is that we are actually going short USD/CAD since we are buying CAD out in the future and *selling dollars*.
6. We are expecting GBP rates to go down and/or US rates to go up.

FOREIGN EXCHANGE SWAPS

INTRODUCTION

WHAT IS A SWAP?

The basic business of foreign exchange, exchanging one currency for another for one point in time, is complemented by a related business, swapping one currency for another for a period of time. Swap transactions are based on the exchange and re-exchange of two currencies for two different value dates. Unlike spot and forward outright trades which trade fixed amounts of the base currency, the swap market trades a fixed amount of either the terms (foreign) currency or the base currency.

- Since there are always two dates involved in a swap, there is always a near date and a far date. Although dealers will do odd-dated swaps with each other, many will be for straight dates. An example of a straight date swap may include the 1-month or 2-month swap, where the far leg falls on a common date across the investing community (1 month from trade date, for example), and where there is likely to be greater liquidity for the customer. An odd-dated swap will include all other dates not falling on a straight date. The two dates involved can be for any business dates with a client.
- There are only two kinds of swaps: (1) a buy/sell swap—buy the fixed currency for the near date and sell it for the far date or; (2) a sell/buy swap—sell the fixed currency for the near date and buy it for the far date. A typical swap would be to buy Yen spot (the exchange) and sell it forward one year (the re-exchange). This would be called a buy/sell Yen swap.
- Before examining how one makes money in the swap market, we must look at several mechanical aspects of the market first. Specifically,
 - Value dates
 - The bid/offer spread
 - Odd-dated swaps
 - Paying vs. earning the points

VALUE DATES

Swaps are categorized by the relative position of the value dates to the trade date or of the value dates to each other. If both the near and far dates are less than one month from the trade date, it is a short-dated swap. If the far date is a forward date (one month, two months), the swap is a forward swap.

Short-Dated Swaps**Near Date****Far Date**

Tomorrow/Next

Tomorrow

Day after tomorrow

Spot/Next

Spot

Day after spot

Spot-a-week

Spot

Same day in following week

Spot-two-weeks

Spot

Same day two weeks later

Forward Swaps**Near Date****Far Date**

Spot/Forward

Spot

A straight forward date

Odd-dates

Spot

A non-straight forward date

Forward/Forward

A straight forward date

A straight forward date

Long-dates

Spot

A forward date past 1 year

QUESTIONS

Today is July 23, 2003.

1. You do a swap which has a near date of July 24th and a far date of July 25th. It is a:

(a) short-dated swap

(b) forward swap

(c) it is called a _____

2. You do a swap which has a near date of August 25th and a far date of September 25th. It is a:

(a) short-dated swap

(b) forward swap

(c) it is called a _____

3. You do a swap which has a near date of July 25th and a far date of July 26th. It is a:

(a) short-dated swap

(b) forward swap

(c) it is called a _____

4. You do a swap which has a near date of July 25th and a far date of August 27, 2003. It is a:

(a) short-dated swap

(b) forward swap

(c) it is called a _____

ANSWERS

1. short-dated; tomorrow/next
2. forward; forward/forward
3. short-dated; spot/next
4. forward; long-dated

QUESTIONS

Refer to the trader's calendar on the following page to answer the questions below. The calendar is open to the spot value date.

1. List the regular forward value dates and number of days in each forward period.

	Date	Days
One month	_____	_____
Two months	_____	_____
Three months	_____	_____
Six months	_____	_____
One year	_____	_____

2. List the dates for each of the following types of swaps.

Tomorrow/next _____

Spot/next _____

Spot-a-week _____

Spot-two-weeks _____

[illegible]

ANSWERS

1.

	Date	Days
One month	Nov. 25	32
Two month	Dec. 24	61
Three months	Jan. 24	92
Six months	April 24	182
One year	Oct. 24	365

2.

	Near date	Far date
Tomorrow/next	Oct. 23	Oct. 24
Spot/next	Oct. 24	Oct. 25
Spot-a-week	Oct. 24	Oct. 31
Spot-two-weeks	Oct. 24	Nov. 7

BID-OFFER SPREADS

The spread refers to the forward part of the swap: the left side is where the market-maker will buy the base currency forward, the right side is where the market-maker will sell the base currency forward. If you see a market of 334-301 for a Sterling swap, you know the market maker will buy forward Sterling at spot less 0.0334 points and will sell forward Sterling at spot less 0.0301 points. The spread is 33 points (0.0033). Consider the following example:

A client wants to Buy/Sell GBP vs. USD Feb. 19, 2003 one-year forward to Feb. 23, 2004.

- The trader takes the opposite side of this transaction.

- This means that the trader will Sell/Buy GBP/USD Feb. 19, 2003 one-year forward to Feb. 23, 2004 i.e. Sell GBP/USD on Feb. 19, 2003 and buy GBP/USD on Feb. 23, 2004.
- Say the spot rate on Feb. 19 is 1.5975 and the points are -334 points. This means that the trader will Sell GBP/USD at 1.5975 on Feb. 19, 2003 and Buy GBP/USD at 1.5641 (1.5975-0.0334) on Feb. 23, 2004.
- You can see that using the 334 points instead of 301 points makes sense since the trader will be buying at a lower rate using the former (1.5641) versus the latter, which would work out to be 1.5674 (1.5975-0.0301).
- The ticket for the trade might illuminate this point:

LEHMAN BROTHERS		Date	FEB 19, 03		Memo
Bank/Customer Account					
Client XYZ					
Broker Rate	WE (+)	USD	Customer Rate	WE (-)	GBP
		1.5975			FEB 19, 03
Broker Rate	WE (+)	GBP	Points	WE (+)	USD
		1.5641	-334		FEB 24, 04
☐ ORDER		☐ LINK		CROSS	
Dealer	Region	Mark Up	Sales Credit	TRADING DESK	
LBFX 8107 (4/94)				Foreign Exchange Trading/Sales	

The two sides of the market come from the underlying Eurocurrency rates available at the time the swap market is quoted. Assume these rates prevail:

	Borrow / "Bid"	Lend / "Offer"
Euro Sterling	9.0 %	9.5 %
Euro dollar	7.0 %	7.5 %

- **Note** In the FX market, one buys and sells currency; in the Eurocurrency market, one buys and lends. The activity is similar; the vocabulary is different.
- Lets say the market-maker does a sell/buy £ swap. In a sell/buy £ swap, the market-maker buys £ forward, so he “sells” Sterling spot. This would leave him short £ “balances” for the period of the swap. A £ loan would produce the same result, so the market he refers to is the offered side of the Euro £ market, in this case 9.5%. Again, the market-maker is selling Sterling spot against dollars, so he is buying USD spot--this leaves him long \$ balances, just as borrowing dollars would. The market-maker buys (borrows) dollars at the bid of 7 %. The differential is 2.5 % which equals 250 points where the market-maker will do a sell/buy Sterling swap.
- Conversely, a buy/sell Sterling swap means the market-maker is selling Sterling forward, so he is buying (borrowing) Sterling spot now and holding it for the period of the swap. The market-maker borrows the Sterling at 9.0%. If the market-maker is buying Sterling against dollar spot, he is naturally selling the dollar spot. He lends the dollar on the offer side at 7.5%. The differential is 1.5% or 150 bps which is where he will do a buy/sell Sterling swap.

The buy (left) side of the swap market is derived from the offered side of the Euromarket for the base currency and the bid side for the terms currency.

The sell (right) side of the swap market is derived from the bid side of the Euromarket for the base currency and the offered side for the terms currency.

- Now let's apply this rule to a case where the swap is quoted in the terms, not the base, currency.

Assume the rates are:

	Borrow/ “Bid”	Lend/ “Offer”
Euro Dollar	8.0 %	8.25 %
Euro Canada	10.25 %	10.50 %

- A client wants to execute a buy/sell CAD swap. In order to figure out which sides of the Eurocurrency market you will use, you must get the swap into the base currency from the market maker's (MM) perspective. The market maker, therefore, is executing a sell/buy CAD swap.
- If the market maker is executing a sell/buy CAD swap, he is naturally executing a buy/sell USD swap. Since the market maker is selling \$ forward, he is borrowing \$ now and lending CAD at today's rates. The MM borrows \$ at the bid of 8.0% and lends CAD at the offer of 10.50%.

QUESTIONS

Indicate which rates the market-maker would use to derive the swap points.

1.)

Euro Dollar	6.75%	7.00%
Euro CHF	4.25%	4.75%

Period: 32 days

Spot: 1.4850 USD/CHF

- a) Bid for forward \$ *(in other words, the Market Maker sells/ buys USD, or buys USD forward and buys/ sells CHF, or sells CHF forward)*
- b) Offer for forward \$ *(Market Maker buys/ sells USD, or sells USD forward)*

2.)

Euro Dollar	7.75%	8.00%
Euro £	10.25%	10.75%

Period: 91 days

Spot: 1.51 USD/£

- a) Bid for forward £
- b) Offer for forward £

ANSWERS

1.) USD/CHF**a) *Bid for forward \$:***

MM buys \$ forward at the bid side of the swap market, so he lends \$ spot at 7% and borrows CHF at 4.25%.

b) *Offer for forward \$:*

MM sells \$ forward at the offer side of the swap market, so he borrows \$ spot at 6.75% and lends CHF at 4.75%.

2.) USD/GBP**a) *Bid for forward £:***

MM buys £ forward at the bid side of the swap market, so he lends £ spot at 10.75% and he borrows \$ at 7.75%.

b) *Offer for forward £:*

MM sells £ forward at the offer side of the swap market, so he borrows £ spot at 10.25% and lends \$ at 8%.

CALCULATING SWAP POINTS

In most cases you will be given the swap points. However, should you need to calculate them, all you have to do is input the appropriate Eurocurrency rates into the formula. This formula is fundamentally equal to the forward point formula:

$$\text{Bid Side Swap Points} = S * (E2 - E1) * (T/360) * 100$$

S = Spot Rate
E1 = Base Currency Lending (Offered) Rate of Interest
E2 = Terms Currency Borrowing (Bid) Rate of Interest
T = Number of Days to Maturity

$$\text{Ask Side Swap Points} = S * (E2 - E1) * (T/360) * 100$$

S = Spot Rate
E1 = Base Currency Borrowing (Bid) Rate of Interest
E2 = Terms Currency Lending (Offered) Rate of Interest
T = Number of Days to Maturity

QUESTIONS

Given the information below, calculate the bid/offer spread on the swap:

Euro \$	7.0-7.25%
Euro NOK	6.0-6.25%
Period	62 days
Spot	7.2525

ANSWER

$$\begin{aligned} \text{Swap market} &= 156-93; & 7.2525 * (7.25 - 6.00) * (62/360) * 100 \\ & & 7.2525 * (7.00 - 6.25) * (62/360) * 100 \end{aligned}$$

RULES OF THUMB

Normally you will not have to derive and calculate the bid/offer sides. Usually you will know spot and swap market; all you will have to do is decide whether to add or subtract the points to get the forward rate. There is a shortcut method for deciding whether to add or subtract the points to get the forward rate which is useful to know when you have to quote a rate quickly.

If the number on the left is larger than the number on the right, subtract the swap points from spot.

If the number on the right is larger than the number on the left, add the swap points to the spot rate.

- For example, you know that the middle market for NOK is 7.2525 NOK/\$ and the points are 154—93.
- Applying the rules above, you would subtract 154 from 7.2525 to get the bid rate for the far date of the swap and 93 to get the offer rate for the far date. The quote would be 7.2371—7.2342.

$$\text{Bid: } 7.2525 - .0154 = 7.2371$$

$$\text{Offer: } 7.2525 - .0093 = 7.2432$$

QUESTIONS

Determine the swap market, using these middle of the market spot rates.

1. Spot NOK = 7.1050; swap points = 95 - 85

Bid:

Offer:

2. Spot £ = 1.5675; swap points = 150 - 142

Bid:

Offer:

3. Spot JPY = 123.50; swap points = 1050 - 1340

Bid:

Offer:

ANSWERS

1. Bid: 7.0955

Offer: 7.0965

2. Bid: 1.5525

Offer: 1.5533

3. Bid: 123.61

Offer: 123.63

PAY OR EARN THE POINTS

Just as we saw in forwards, you will either earn or pay the points in a swap.

- If you are paying the points in the forward, you are also paying them in the swap. Assume you do a Buy/Sell Yen swap against the dollar (+ = buy; - = sell):

Near Date

Far Date

+JPY/-USD

-JPY/+USD

- When we described how to figure out if you are paying or earning points in forwards, we said that if you were invested in the low interest rate currency for the period preceding the forward date, you would earn the points since you were losing in the interest rate differential.
- With a swap, it is exactly the same. In the example above, you have bought Yen spot.
 - So you will invest the Yen for the period of the swap and earn the rate available in the Euro Yen market.

- Assuming JPY rates are lower than USD rates, you will earn the points in a buy/sell JPY swap to compensate you for the loss in the interest rate differential.

- Many dealers find it easier to use a couple of shortcut methods in thinking of forward points.
 - First, as always, think in terms of the base.
 - Second, determine whether the base interest rate is higher or lower than the terms rate. Then, do what the chart tells you to do.
 - This is true for currencies on both U.S. and European terms, whether you are buying or selling the base currency.

	Add Points	Subtract Points
Base Rate Higher		X
Base Rate Lower	X	

THE RATIONALE BEHIND THE CHART

If the base rate is higher, you subtract the points.

- If you are *selling the base currency at the forward date*, theoretically you will hold the higher yielding base currency in the interim; since you are earning the higher interest rate, you must “pay” the points with a less advantageous forward rate, i.e. your forward rate will be lower.
 - CHF points are 0.0046 and spot is 1.5910. Assuming dollar interest rates are higher than CHF rates, the forward rate would be 1.5864. It is less advantageous to sell \$ at 1.5864 CHF than at 1.5910. Therefore, you have paid for the higher interest rate with a lower forward rate.
 - £ points are 0.0550 and spot is 1.8000. Assuming £ interest rates are higher than \$ interest rates, the forward rate would be 1.7450.
- If you are *buying the base currency at the forward date*, theoretically you will hold the lower yielding terms currency in the interim; since you are earning the lower interest rate, you will be compensated by earning points with a more advantageous forward rate. Again, the forward rate will be lower—it is more advantageous to buy the base at a lower rate. Referring to the examples above, it is more advantageous to buy \$ at 1.5864 CHF and to buy £ at 1.7450.

If the base rate is lower, you add the points.

- If you are *selling the base currency forward*, theoretically you will hold the lower yielding base currency and, therefore, must “earn” points with a more advantageous forward rate. By adding the points, the forward rate becomes higher than spot. It is advantageous to sell the base for a higher rate.
 - *If you are buying the base currency forward*, theoretically you will hold the higher yielding terms currency. Since you earned the higher interest rate, you will pay in the points by paying more for the base currency in the future than you would have spot.

QUESTIONS

- Give the relative interest rates below, decide (1) whether you pay or earn the points and (2) whether you add or subtract the points. In all cases, the swap is against the dollar.

USD rates > CHF rates

GBP rates > USD rates

CAD rates > USD rates

USD rates > JPY rates

1. Buy/Sell CAD swap
 - (a) Earn points
 - (b) Pay points
 - (c) Add/Subtract points
2. Sell/Buy CHF swap
 - (a) Earn points
 - (b) Pay points
 - (c) Add/Subtract points
3. Buy/Sell \$ against £ swap
 - (a) Earn points
 - (b) Pay points
 - (c) Add/Subtract points
4. Sell/Buy CAD swap
 - (a) Earn points
 - (b) Pay points
 - (c) Add/Subtract points

5. To earn the points, you would do a:

(a) Buy/Sell JPY swap

(b) Sell/Buy JPY swap

6. To pay the points, you would do a:

(a) Buy/Sell CAD swap

(b) Sell/Buy CAD swap

ANSWERS

1. (b) pay by adding the points; by buying CAD spot, you have them to invest for the period of the swap; since you are investing in the higher interest rate currency in the Eurocurrency market, you will pay the points in the swap by paying more CAD per \$ in the forward part of the swap.
2. (b) pay by subtracting the points; since you are selling CHF spot, you are remaining in dollars spot—the higher interest rate currency. Again, since you are earning the interest rate differential, you will pay the points in the swap by getting fewer CHF per \$ in the forward part of the swap.
3. (a) earn by subtracting the points; since you are buying dollars spot, you will be in the lower earning currency in the deposit market, so you earn the points in the swap by paying fewer \$ forward per £ in the forward part of the swap.
4. (a) earn by adding the points; you are selling the higher interest rate currency spot and buying the lower one (dollars); since you will be invested in the lower interest rate currency during the swap, you will earn the points by getting more CAD per \$ in the forward part of the swap.
5. (a) Buy/Sell JPY swap; since you will be invested in the lower interest rate currency, you will earn the points.
6. (a) Buy/Sell CAD swap; since you are buying the CAD you will gain the interest rate differential, so you will pay the points.

LEARNING POINTS

You now know all the mechanical details you need related to swaps:

- How to determine value date
- The source of the bid/offer spread
- How to calculate the spread
- A shortcut for adding or subtracting the points to get the forward rate
- Whether you pay or earn the points

SUMMARY

- The difference between the spot and forward outright is the swap.
- Swap points translate the interest rate differential between two currencies into foreign exchange terms.
- Swaps are categorized by the relative position of the value dates to the trade date or of the value dates to each other.
 - *Short-dated swaps*: both the near and far dates are less than one month from the trade date.
 - *Forward swaps*: the far date is a forward date.
- When you put on a swap, you must either unwind it by putting on an offsetting swap or you must finance it.
- A swap represents a view on the interest rate differential; you would not put on a swap because of your view on exchange rates.
- With a swap you are trading the interest rate differential between two currencies. You do not put on a swap unless you have an interest rate outlook.
 - If you expect the interest rate differential to widen, you want to pay the points now and earn them in the unwind; conversely, if you expect the

differential to narrow, you want to earn the points now and pay the points in the unwind.

- If the swap points indicate a differential that is wider than the actual differential in the Eurocurrency market, you would want to earn the points in the swap and finance it in the Euromarket.
- The left side of a swap quotation is the market-maker's bid for the base currency for the forward value date and the right side of the quotation is the offer for the base currency for the forward value date.

- Left side:

Buys base currency for forward value Sells base currency for spot value
--

- Right side:

sells base currency for forward value buys base currency for spot value
--

- If the market maker executes a buy £ spot sell £ forward swap, he or she will deal on the offered side of the forward market and the bid side of the spot rate.
- Although the points may be the same, the quoted forward outright rate and the swap rates often are not the same.
- The bid/offer swap points are derived for the rates available in the Eurocurrency market:
 - The left side of the swap market is derived from the offered side of the Euromarket for the base currency and the bid side for the other currency.
 - The right side of the swap market is derived from the bid side of the Euromarket for the base currency and the offered side for the other currency.

FOREIGN EXCHANGE OPTIONS

INTRODUCTION

FX OPTIONS

AN INTRODUCTION TO FOREIGN EXCHANGE DERIVATIVES

INTRODUCTION

Corporate treasurers, pension funds, hedge funds, and individual investors all use options, often for different reasons. Options can be used to hedge cash flows, leverage capital, or to take esoteric views (i.e., an investor believes that U.S. two-year interest rates will rise relative to Japanese 2-year rates over the next two months, but will not do so by more than 10 bps with certainty.). As useful and flexible as options are for the investor, they also carry many risks that should be clearly understood.

The following will give a brief introduction in FX options including:

- What they are...
- How they trade...and...
- What their risks are and how they are measured

VANILLA OPTIONS

An Option contract provides the buyer with the right, not the obligation, to buy or sell the underlying asset at a pre-determined price at a future date. The right to buy an asset is a “call” option, whereas the right to sell is as a “put option”. These basic options are also known as “vanilla” options, as their payoffs and risk management are relatively straightforward.

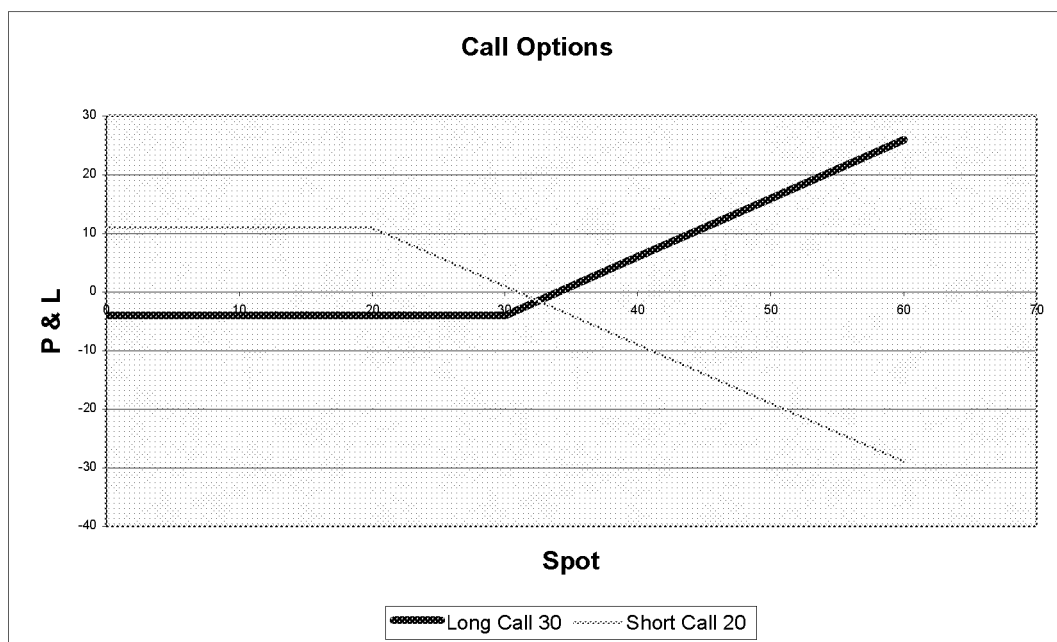
Option payout at maturity:

- **Call:** $\text{Max}\{0, \text{Spot}_{\text{maturity}} - \text{Strike}\}$
- **Put:** $\text{Max}\{0, \text{Strike} - \text{Spot}_{\text{maturity}}\}$

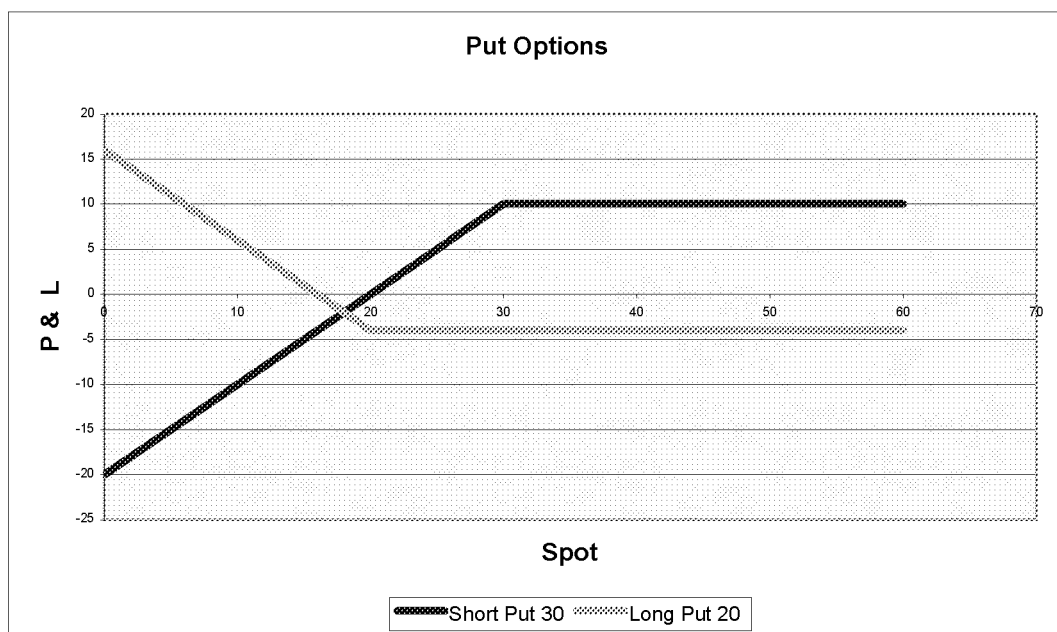
Example:

An investor purchases a 1-month call option on Lehman Stock with a strike of \$55 (currently trading at \$54) for a premium of \$7. In one month's time, if Lehman stock is trading above \$55 then the option is “in-the-money” and the investor will “call” the stock at \$55. However, the investor will not realize a profit unless the stock trades above \$62 ($= 55 + 7$).

PAYOFF OF A LONG AND SHORT CALL OPTION



PAYOFF OF A LONG AND SHORT PUT OPTION



We can decompose an option's value into two distinct buckets; **intrinsic value** (how much the option is "in-the-money"), and **time value** (how much value the option holds because the price can move between now and expiration).

The following expression will always hold:

$$\text{Option Value} = \text{Intrinsic Value} + \text{Time Value}$$

Further more, time value is a function of more than just time to expiry:

$$\text{Time Value} = f(\text{\# days to expiry, volatility})$$

In other words, all else being equal, an option with more time to expiration and/or more volatility will be more expensive.

THE GREEKS

We refer to option risks as "The Greeks". An option position will generally have the following risks:

- Underlying Asset Value (Spot or Forward)
- Volatility
- Interest Rates
- Time

The Greeks are a measure of how the value of the option changes with respect to the key risk parameters. To fully understand the risks of an option position, you need knowledge of the Greeks. This understanding will allow you to anticipate how market changes will affect the value of your position.

VOLATILITY

Volatility is the annualized standard deviation of returns. More importantly, it is the only parameter not explicitly specified between the two parties entering an options contract. Therefore, volatility is the only parameter in the pricing of an option whose level changes due to market forces. Volatility is what option traders actually trade.

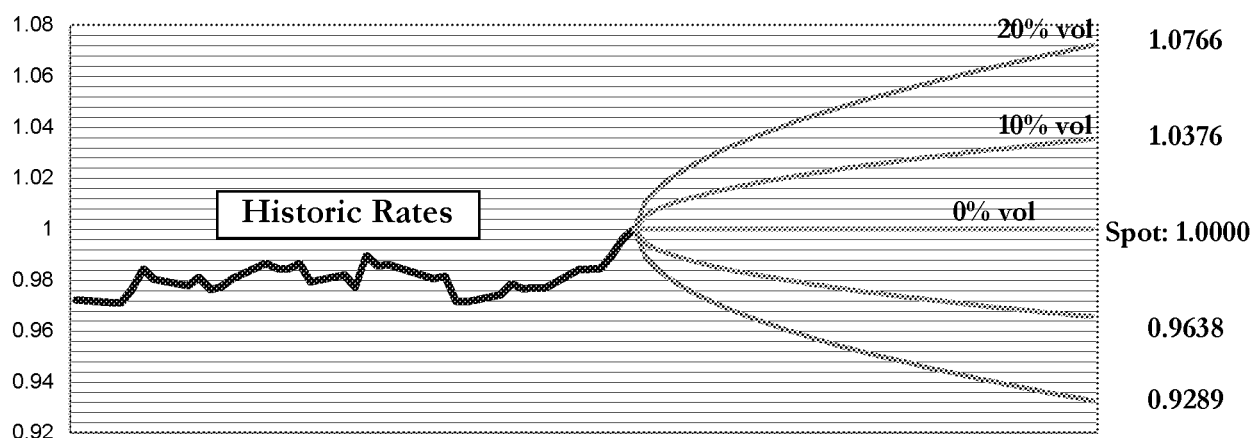
Historical volatility: Measures volatility in the past and is used as a basis for what to expect going forward.

Implied volatility: The market's expectation of future volatility. Implied volatility is what is "implied" in the price of an option. We extract the implied volatility using the Black-Scholes option pricing formula.

Traders will often refer to volatility as premium. They will say things like, “premium levels are high” or “premium levels are low.” What the trader is really referring to is implied volatility.

A volatility cone helps to illustrate the impact of higher volatility on possible price scenarios. A higher volatility will result in a wider range of possible values for the underlying.

VOLATILITY CONE



DELTA

Delta is the sensitivity of the option value to a change in price of the underlying. In general, delta is only accurate for small price changes in the underlying.

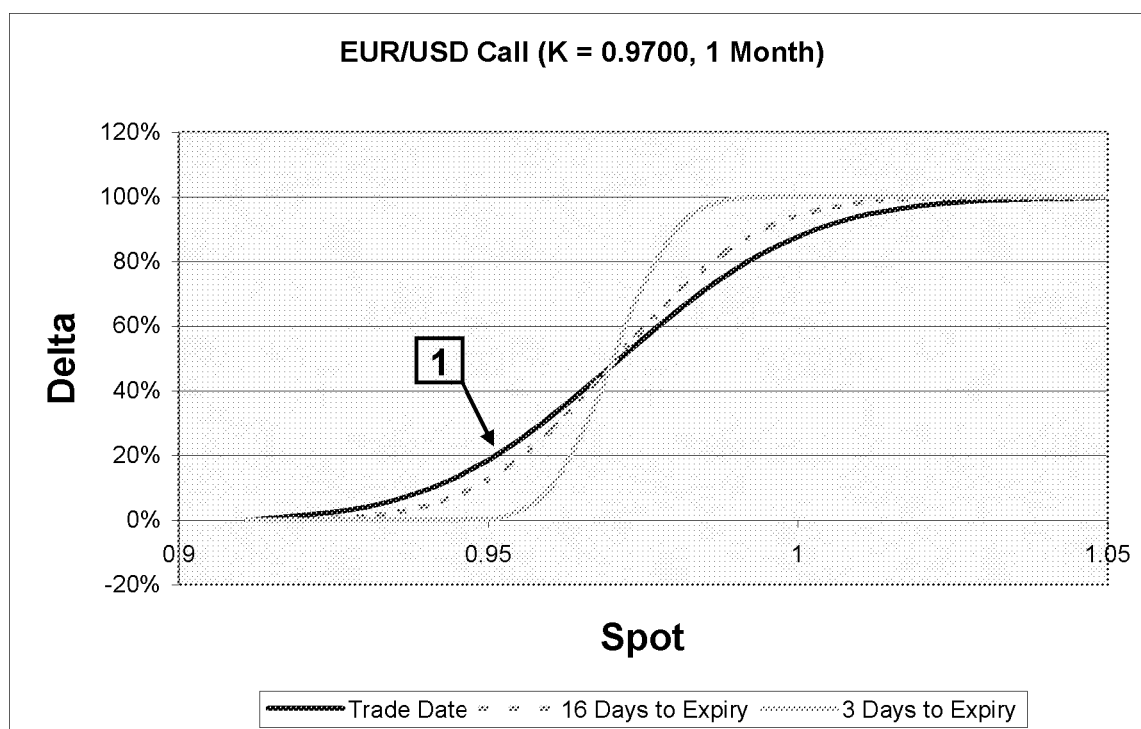
$$\delta = \Delta \text{ Value} / \Delta \text{ Spot}$$

The delta of a long call position is always positive, while that of a long put position is always negative. It can be useful to think of delta as the probability of an option finishing in the money. For example, an option with a strike price set at the current spot value will have a delta approximately equal to 50%. This makes intuitive sense, as one would expect the option to have about a 50/50 chance of expiring in the money. However, this rule of thumb should be used with caution as exotic options can have deltas dramatically higher than 100%.

Deep in the money options will have a delta close to 100%. In other words, the price of the option will change in value one-for-one with the price of the underlying. The option is almost certain to finish in the money.

Conversely, when the option is deep out of the money, delta is close to 0% as it is very unlikely that the option will be exercised.

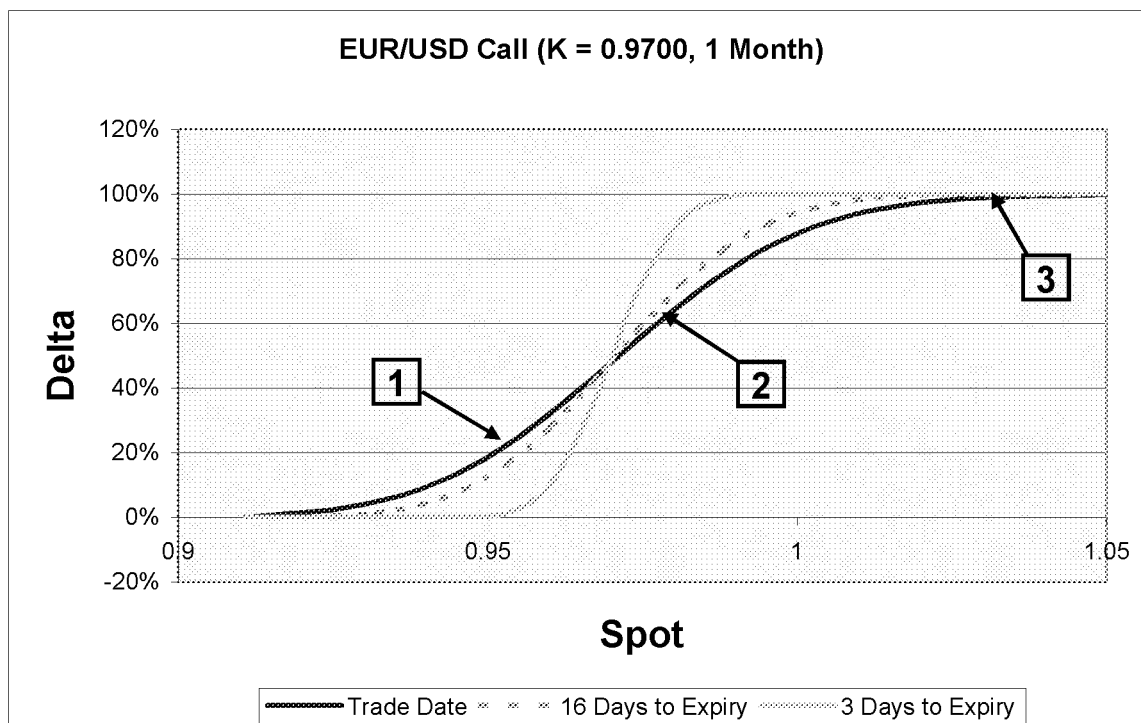
DELTA RANGES FROM 0% (DEEP OTM) TO 100% (DEEP ITM)



Looking at the above graph, we can walk through an example of how to delta hedge a plain vanilla call option. Using the dark solid line labeled “Trade Date”, we will see how a change in spot price will require the trader to dynamically hedge the position.

For this example, assume that the investor has invested in 100MM notional of a EUR/USD one month 0.9700 EUR call. **(NOTE:** It may be instructional to pause here and note that a call on one currency is equivalent to a put on the counter currency. Hence, in this example it is equivalent to say that the investor is buying a USD put).

At point 1, our call is equivalent to owning 20% (being long) of the notional in the underlying currency. To hedge this position the trader would sell 20MM EUR/USD. This would make us delta neutral over a small range in spot (i.e., 0.9495 to 0.9505). As can be seen in the above graph, the delta changes as spot moves requiring dynamic hedging for the trader to remain delta neutral.



As spot moves from point 1 to point 2, delta changes to 60%. As we have already sold 20 MM EUR/USD against the option, we would need to sell 40MM *more* EUR/USD for a total of 60MM EUR/USD. At point 3 we would need to sell an additional 40MM EUR/USD for a total of 100MM.

<i>Point 1</i>	- 20 MM
<i>Point 2</i>	- 40 MM
Net	- 60 MM
<i>Point 3</i>	- 40 MM
Net	- 100 MM

GAMMA

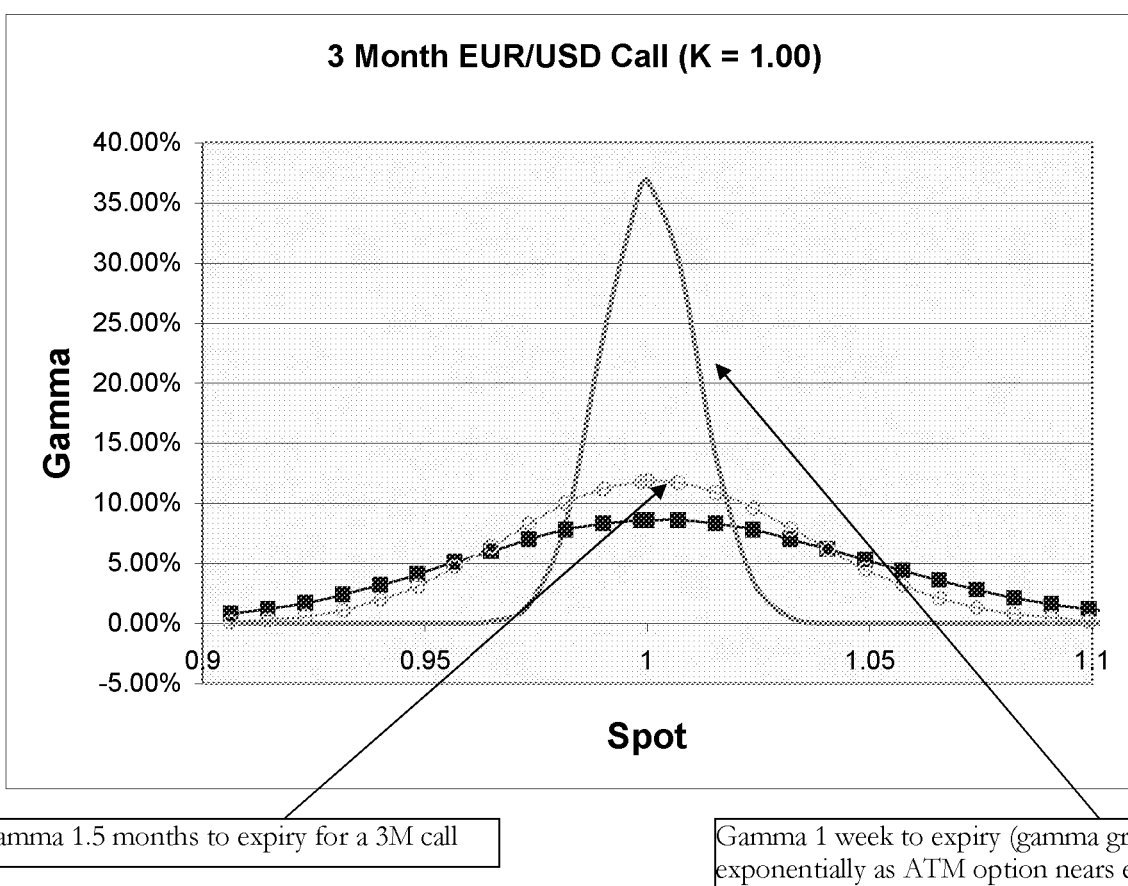
Gamma is the sensitivity of delta to changes in price of the underlying.

$$\Gamma = \Delta \text{ Delta} / \Delta \text{ Spot}$$

In the above hedging example, delta vs. spot is not a linear relationship, which causes the speed of delta's change to increase/decrease as spot moves. This curvature is known as gamma. Gamma is a valuable property for the owner of an option. As spot goes up, the owner of the option becomes longer the underlying. As spot goes down, the owner of the option becomes shorter the underlying. This property does not come freely as the option holder must pay for this attractive property in the form of premium.

Gamma is, by definition, always positive. Therefore, the holder of an option is long gamma, and the seller of an option will be short gamma. Gamma will typically be greatest when an option is at the money and will increase as the option approaches expiry. As spot moves away from the strike, gamma will trend towards zero.

If gamma is small, there is little change in delta as spot moves. Therefore, the adjustments necessary to keep a portfolio delta neutral are smaller and infrequent. Conversely, if gamma is large, the adjustments are larger and more frequent. For options near expiry and at the money, gamma will become very pronounced and occupy the options trader's every thought.



The example below will illustrate how keeping a position delta neutral is a dynamic process and how the trader must trade his/her gamma. Note in the example that being long an option (and long gamma) requires that an investor buy high and sell low to remain hedged.

TRADING GAMMA ON A LEHMAN CALL OPTION

	<u>Action</u>	<u>Net Position</u>
♦ You buy one call option for \$200 (option to buy 100 shares of Lehman at \$100). – Strike = 100; Stock _{Today} = 100 – ATM, Delta = 50%		
♦ You hedge the delta by selling 50 shares of Lehman.	Sell 50 shares	<i>-50 shares</i>
♦ Positive news is released: New analyst class hired by Lehman. Stock moves to \$110. – Delta has moved higher to 80%. – We now have to add to our hedge. Sell 30 more shares of Lehman to be delta neutral.	Sell 30 shares	<i>-30 shares -80 shares</i>
♦ Negative news is released: Names of new FX analyst class are published in the WSJ! Stock plummets to \$85. – Delta has move lower to 25%. – We now have to unwind some of our hedge. Buy 55 shares of Lehman to be delta neutral.	Buy 55 shares	<i>+55 shares -25 shares</i>
♦ We reach expiry and market drifts back to strike price. – Stock is back at \$100 at expiry. – Option expires worthless. – Unwind delta hedge. Buy 25 shares.	Buy 25 shares	<i>+25 shares 0 shares</i>

P&L ON GAMMA HEDGING EXAMPLE

<u>Action</u>	<u>Net Cash Flow</u>	<u>Intrinsic Option Value</u>	
Buy Option	(\$200)	\$0	
Sold 50 shares @ \$100	<u>+\$5000</u>	<u>\$0</u>	
	+\$4800	\$0	
Sold 30 shares @ \$110	<u>+\$3300</u>	<u>\$1000</u>	
	+\$8100	+\$1000	
Bought 55 shares @ \$85	<u>(\$4675)</u>	<u>\$(-1000)</u>	
	+\$3425	+\$0	
Bought 25 shares @ \$100	<u>(\$2500)</u>	<u>\$0</u>	<u>Net P&L</u>
	+\$925	\$0	+\$925

It is interesting to see that in the above example that even though the option expired worthless, the option holder realized a profit. The reason for this helps to explain why volatility determines the price of an option. The realized volatility experienced in the underlying (Lehman stock) was *higher* than the implied volatility. When realized volatility is higher than implied (what the option holder pays), they will realize a profit regardless of the directional move of the underlying (assuming the holder of the option hedges the gamma). Also, note the positive property of gamma again....you sell as price increases and buy as price decreases.

Market makers are constantly trying to trade their gamma. If an options book is long gamma then the trader is long optionality. If the trader does not trade the gamma, they will have a negative P&L resulting from time decay. If the trader does not believe the gamma is worth the time decay (i.e., realized volatility will be lower than implied) then he/she will sell options into the market to reduce their gamma profile.

Option traders are in a constant battle against time decay unless they are short gamma. However, being short gamma does not come without consequence. Short gamma traders have to sweat out the exact opposite; If spot starts to jump around wildly (e.g., high realized volatility) they will experience large losses as they now have to buy at the highs and sell at the lows to remain delta neutral. No free lunch.

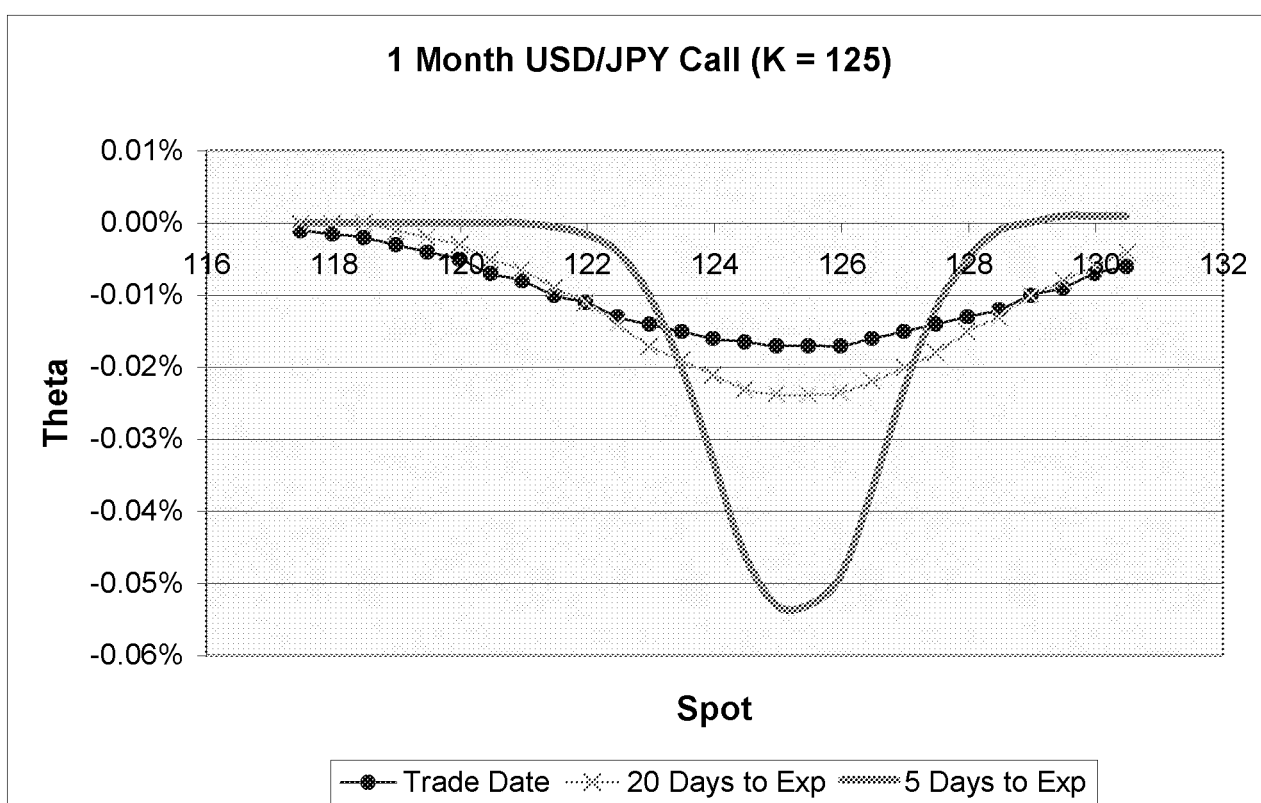
THETA

Theta is the change in option value with respect to time.

$$\Gamma = \Delta \text{Value} / \Delta \text{Time}$$

Theta is usually negative for an option because as time passes, the option becomes less valuable. This erosion of option value as time passes is known as *time decay*. Time decay accelerates as the option approaches expiry.

Theta decreases when an option is either deep in or deep out of the money. Theta's absolute value is typically greatest at the money (see graph below for illustration).

**VEGA**

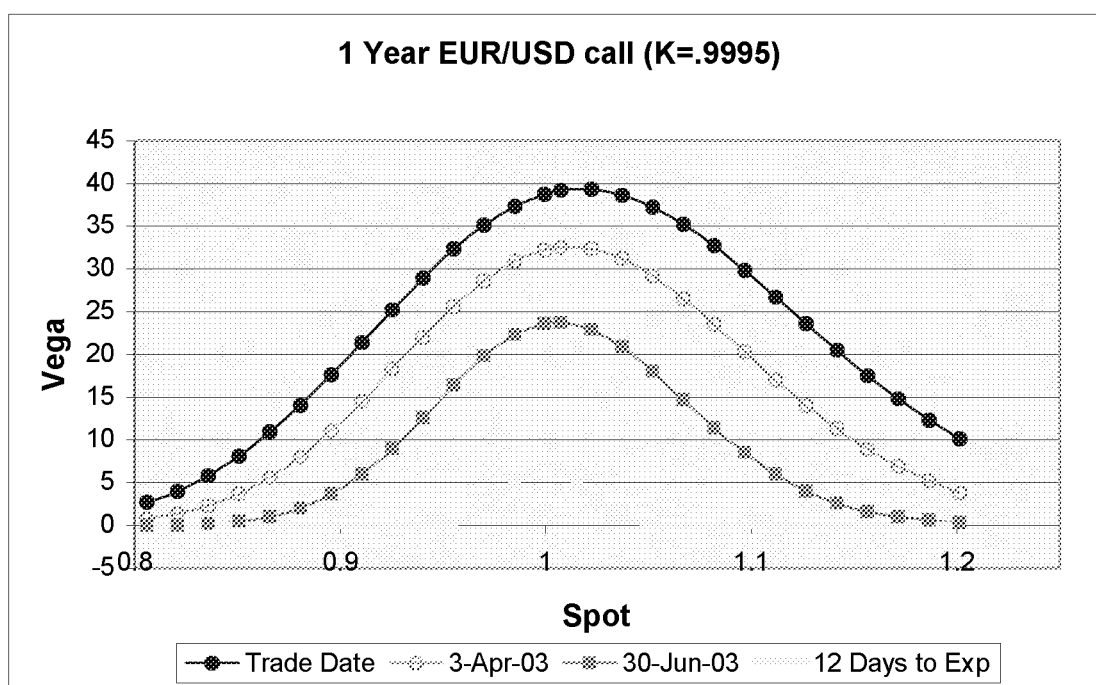
Vega is the change in option value for a unit change in the volatility of the underlying.

$$v = \Delta \text{Value} / \Delta \text{Volatility}$$

If vega is high in absolute terms, the option is very sensitive to changes in volatility. If vega is low in absolute terms, volatility changes have relatively little impact on the value of an option. Vega is greatest for at the money options and decreases as an option approaches

expiry (see illustration below). Buyers of options are long vega and will see mark-to-market profit if implied volatility increases.

You will hear traders say things like, “I was just given 100 thousand of vega.” This means that the trader just paid for options, making his books longer volatility. A one percent move down in volatility will result in a 100 thousand dollar loss. The trader would typically enter the inter-bank market to off-load some of this risk. By doing so, he risks the possibility of depressing volatility levels and hurting his now long vega position. Trading to minimize this impact is what differentiates a good trader.



RHO

Rho is the change in option value for a unit change in the interest rate differential.

$$\rho = \Delta \text{Value} / \Delta \text{Volatility}$$

As the base currency's interest rates increase, the value of the forward on the base will decrease if all else is held constant. Therefore, the value of a call option on the base currency will decrease and the value of a put will increase.

As the base currency's interest rates decrease, the value of the forward will increase. Therefore, the value of a call on the base currency will increase.

Rho is not always at the forefront of the traders mind. However, when their rho exposure becomes sufficiently large they will take action to reduce their interest rate exposure. Typically, interest rate exposure is hedged using forwards.

Example: If the EUR/USD book has 100k in rho exposure, this means a 1% shift in the interest rate curve will result in a 100k P&L move. Let us assume a 1% increase in euro rates results in a profit. To hedge this exposure, the options trader would want to buy EUR (sell USD) forward. Why? If euro rates increase, the option position will show a profit and the forward position will show an offsetting loss (as an increase in euro rates will depress the value of the forward).

SECOND ORDER GREEKS

Second order greeks are an important risk measure for the options trader. They are typically more significant when exotic options are a consideration. If the trader is not aware of these second order risks, they can find themselves in significant trouble.

NOVA

Nova is the sensitivity of the option's vega for a unit change in the volatility of the underlying. Traders sometimes refer to nova as "vol gamma". This is because gamma is to delta as nova is to vega.

A long nova position will benefit if the volatility of volatility is high. As volatility increases, the long nova position will become longer vega and vice-versa. This, much like gamma, does not come without cost. Vol gamma is not free and if the volatility of volatility (called v-vol) is low, the option's trader will lose money as the option decays away.

DERIV

Deriv is the sensitivity of the option vega to a change in price of the underlying. Deriv is closely related to risk reversals (which will be talked about in a later section).

FACTORS AND THEIR EFFECTS ON OPTION VALUE

Call Option

<u>FACTOR</u>	<u>MOVE</u>	<u>PRICE</u>
Spot _{Base}	Up	Up
Strike	Up	Down
Volatility	Up	Up
Time	Up	Up

Put Option

<u>FACTOR</u>	<u>MOVE</u>	<u>PRICE</u>
Spot _{Base}	Up	Down
Strike	Up	Up
Volatility	Up	Up
Time	Up	Up

It is important to note that increased time to expiry and increased volatility will always make a call and put option more valuable. However, this rule does not always hold for exotic options.

EXOTIC OPTIONS

The term “exotic options” covers a broad array of option products. These include barriers, average rates, baskets, etc. To help understand the unique nature of the risks of exotics we will walk through an example of one of the more popular exotic options...a reverse knockout.

REVERSE KNOCK-OUT (BARRIER OPTION FAMILY)

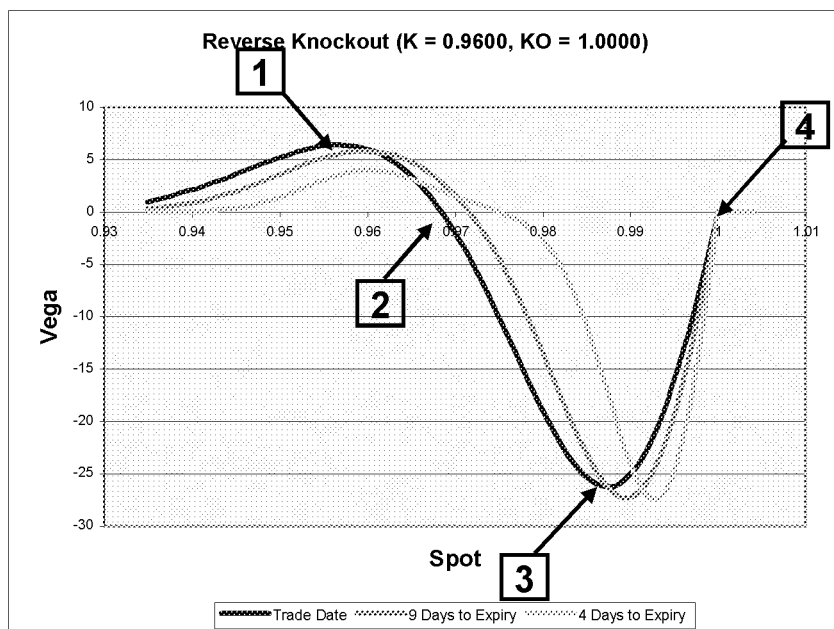
A reverse knockout is a special option that “knocks out” when it is in the money. For example, a call option with a strike of 1.1000 and a knockout at 1.1200 is known as reverse knockout. The call option has value when spot is greater than 1.1000, however, if spot *ever* touches 1.1200 or higher then the option expires worthless. This strategy is often attractive to investors who would like to take a directional view but would like to reduce the amount of premium they must pay for the option. Loosely speaking, a knockout is a combination of a vanilla option and a one-touch barrier option. The owner of a reverse knockout on a call option is long a vanilla call and short the one-touch at the barrier.

Barrier options present unique challenges to the option’s trader. As the option approaches the barrier, the greeks tend to fluctuate wildly. This instability makes hedging the option very expensive. The following example and graphs will help to illustrate these challenges.

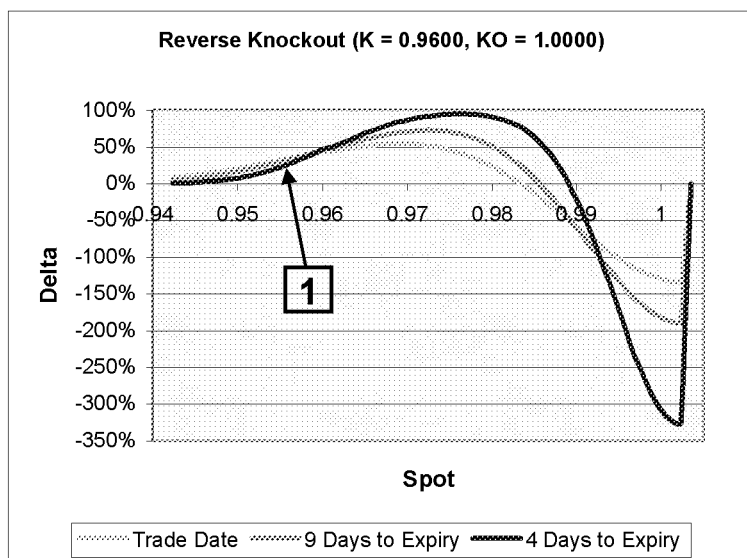
Example:

- Strike: 0.9600
- Knock-out: 1.0000
- Tenor: 2 weeks
- Notional: 100 MM

First, we will look at how vega behaves for this reverse knockout (also referred to as an “up and out call”), and then we will look at the delta of the option and an example of delta hedging a reverse knock-out.

VEGA OF A REVERSE KNOCK-OUT

- ◆ At point 1, our option is out-of-the-money, and our vega is positive.
- ◆ At point 2, our option is in the money, but vega is neutral. More money can be made, but if spot increases too much, it is knocked out.
- ◆ At point 3, our option is deep in the money and our vega is highly negative. An increase in volatility can easily knockout the option or move it OTM. Volatility is the enemy.
- ◆ At point 4, the option is knocked out and vega is zero.

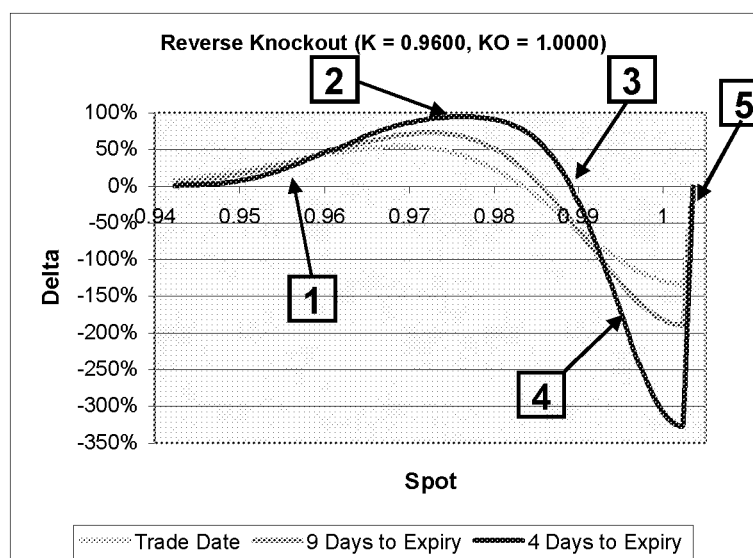
DELTA OF A REVERSE KNOCK-OUT

- ◆ 1 - Delta = Long 25% (25 MM)
- ◆ 1 - Hedge = Short 25% (25 MM)

◆ At point 1, our R.K.O. is equivalent to owning 25% (25 MM) of the notional in the underlying currency (EUR).

◆ To hedge, we would sell EUR/USD 25 MM.

◆ This would make us Delta neutral over a small range in spot (i.e., EUR/USD 0.9550 to .9555)

DELTA HEDGING OF A REVERSE KNOCK-OUT

	Net
◆ Point 2, sell 75 MM <u>more</u> EUR/USD.	-100
◆ Point 3, <u>buy</u> 100 MM EUR/USD.	0
◆ Point 4, buy 200 MM <u>more</u> EUR/USD.	+200
◆ Point 5, <u>sell</u> 200 MM EUR/USD (Option Knocked Out).	0

Notice the extreme volatility of the delta as spot moves from point 2 to 5. At point 2 we are *short* 100MM EUR/USD as a hedge and then we are *long* 200MM EUR/USD at point 4. A swing of 300MM EUR/USD! This hedging can be very expensive for the trader.

TRADING CONVENTIONS

This section is meant to help familiarize you with some of the terminology and conventions you will hear bantered about on the desk.

Volatility Smile: In theory, given a constant underlying asset, all options should trade at the same implied volatility. However, markets tend to price out of the money options at a higher implied volatility. Therefore, the potential price scenarios have “fat tails.” This phenomenon is known as a “Volatility Smile”. The smile describes the shape of the volatility vs. spot price curve. Numerous theories abound as to the reasons for this smile...talk to your favorite options trader for his/her take.

Volatility Skew: The volatility skew is apparent in risk-reversals (long (short) a call and short (long) a put). In most currency pairs, either the call or the put is “better bid”. For example, if a trader tells you the 1 month, 25 delta risky is trading at 0.80 better bid for the calls, this means that 25 delta calls trade at a volatility 0.80 higher than 25 delta puts. The 0.80 is a relative number and the trader/salesperson must have an idea of the actual volatilities to give an accurate price. This is the “skew” in the volatility curve.

Puts/Calls: In foreign exchange, if you are buying a call on the EUR/USD then you are, equivalently, buying a put on the USD. In fact, to make your request clear to the trader it is useful to specify both conventions. When purchasing a JPY call, it is helpful to say, “I would like to price a USD put, JPY call.” This makes it absolutely clear the direction for which you are interested. If you ask for upside in USD/JPY, it is unclear if you want JPY

upside (which would be a USD put) or USD upside (which would be a USD call). Being completely explicit will avoid confusion and costly errors.

TV: TV is shorthand for theoretical value. In general, vanilla options trade at or near theoretical value (save the skew and smile effects) and traders quote them with one price. Exotic options, however, are usually quoted using two prices. Typically, the trader will state the TV (as given by Black-Scholes theoretical pricing formula) and a spread to TV. This spread must be added to (or subtracted from) the TV to get the actual price. Pricing this spread is an art form that requires an in-depth understanding of exotics and how the market prices them.

V-vol: Traders refer to the volatility of volatility as v-vol. V-vol is used to describe the stability of implied volatility for a given currency pair.

Barriers: Barrier options are a concern for option traders, spot traders, and investors. As barrier options are triggered, tremendous stop loss/take profit orders may be triggered. These orders can cause large movements in the spot market. It is important to be aware of major barriers and their potential impact on the market.

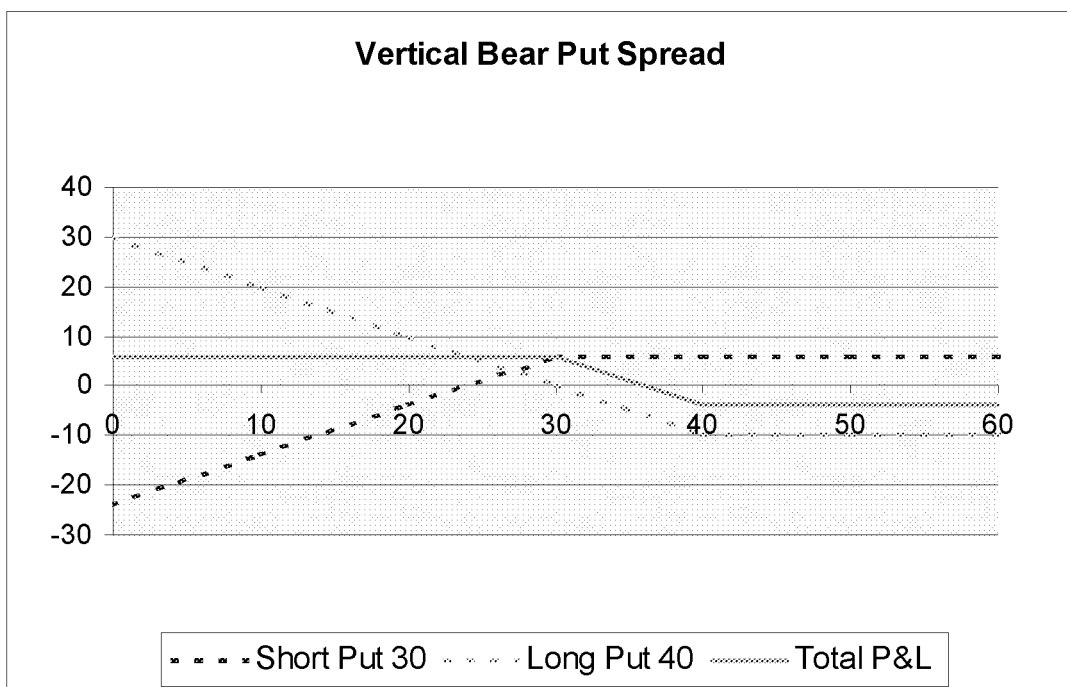
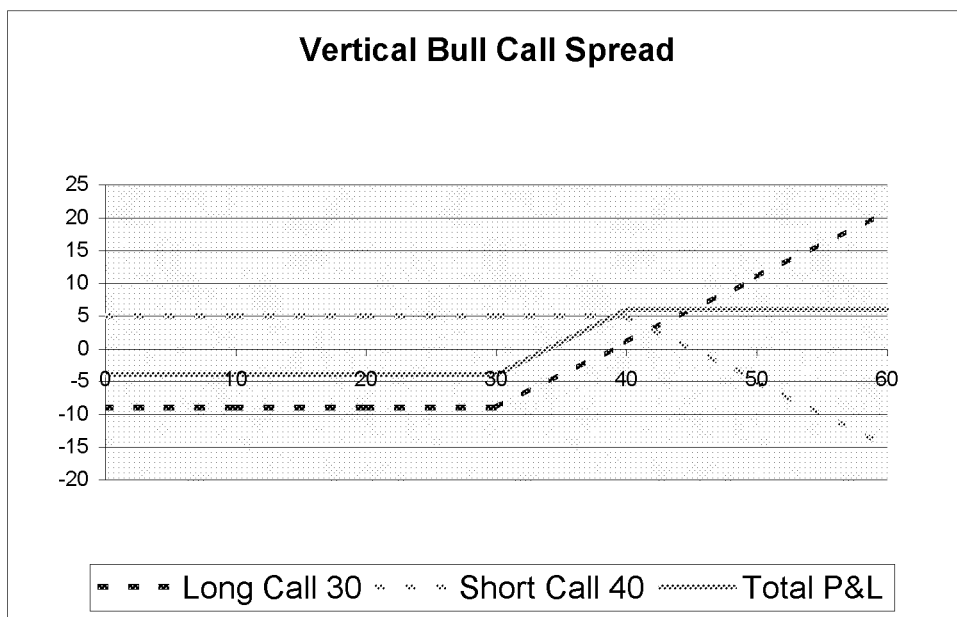
TRADING STRATEGIES

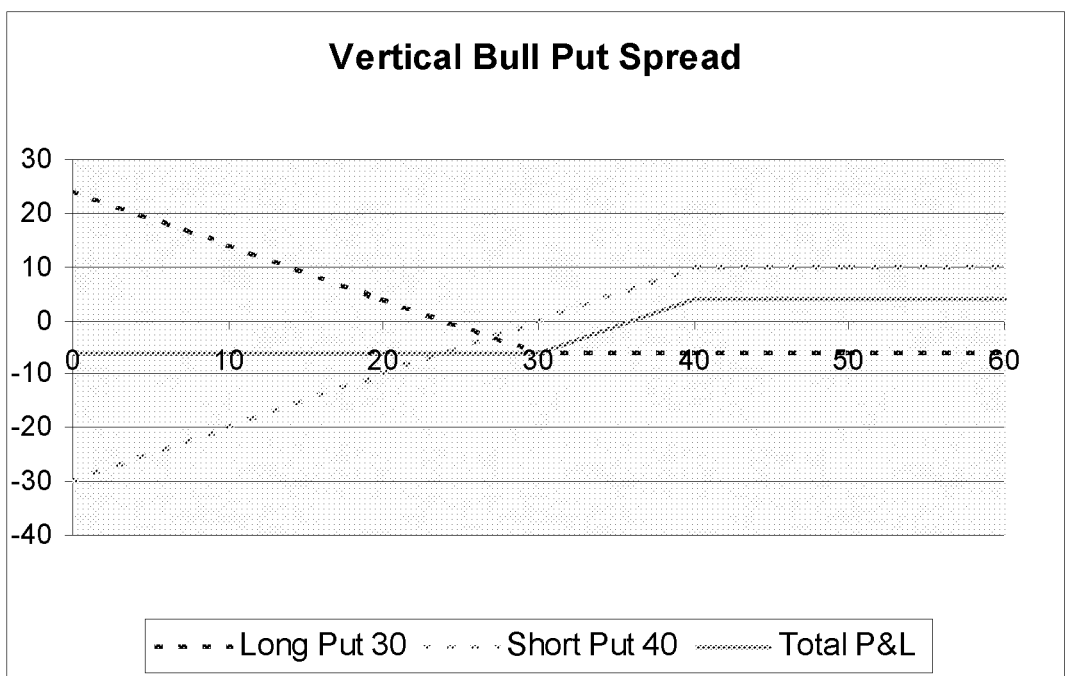
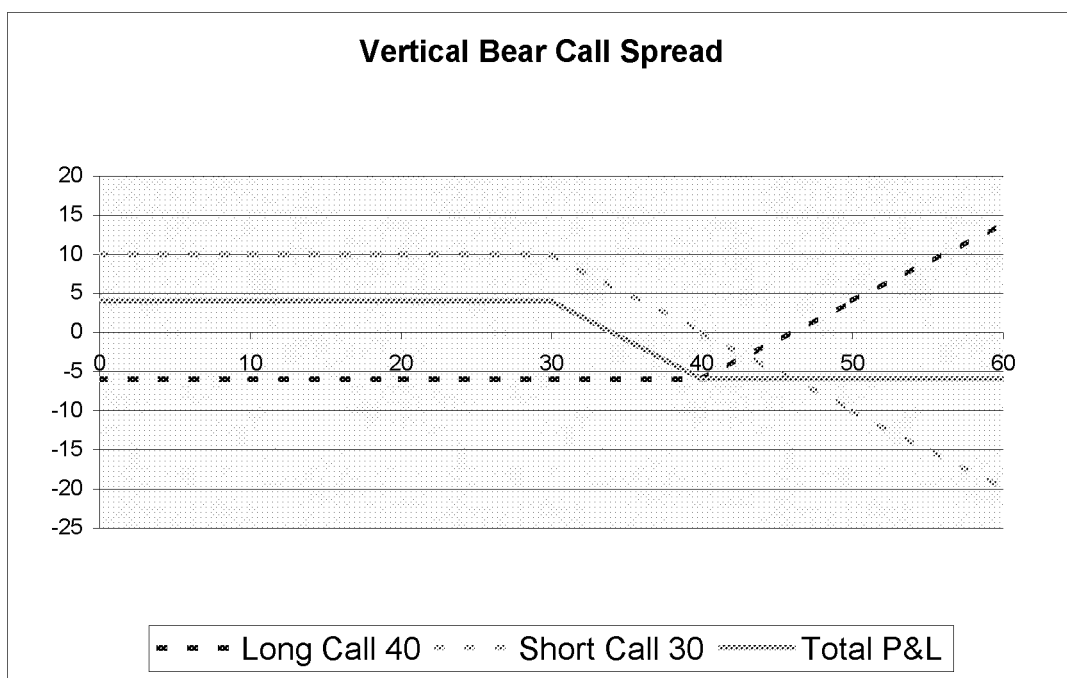
This section will describe and visually present several of the more common option strategies used by investors. It is helpful to memorize these strategies. Once you become familiar with the language, then you can focus on important issues.

Call Spread (Put Spread)

The general concept behind the call spread is to take a directional view while giving away some of the upside participation to cheapen the upfront premium paid. For example, an investor may purchase a 1.10 call and sell a 1.15 call against it. The option will be in the money above 1.10 but profits are capped at 1.15 as the short position nets out any further gains. The upfront cost is lower than the solo vanilla as the investor has sold any upside participation above 1.15.

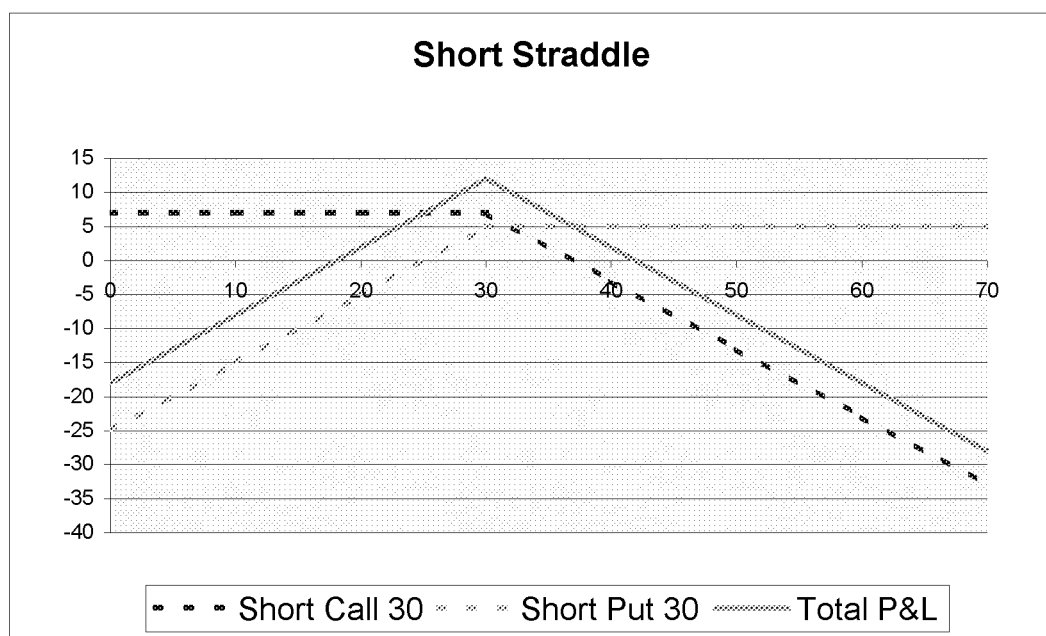
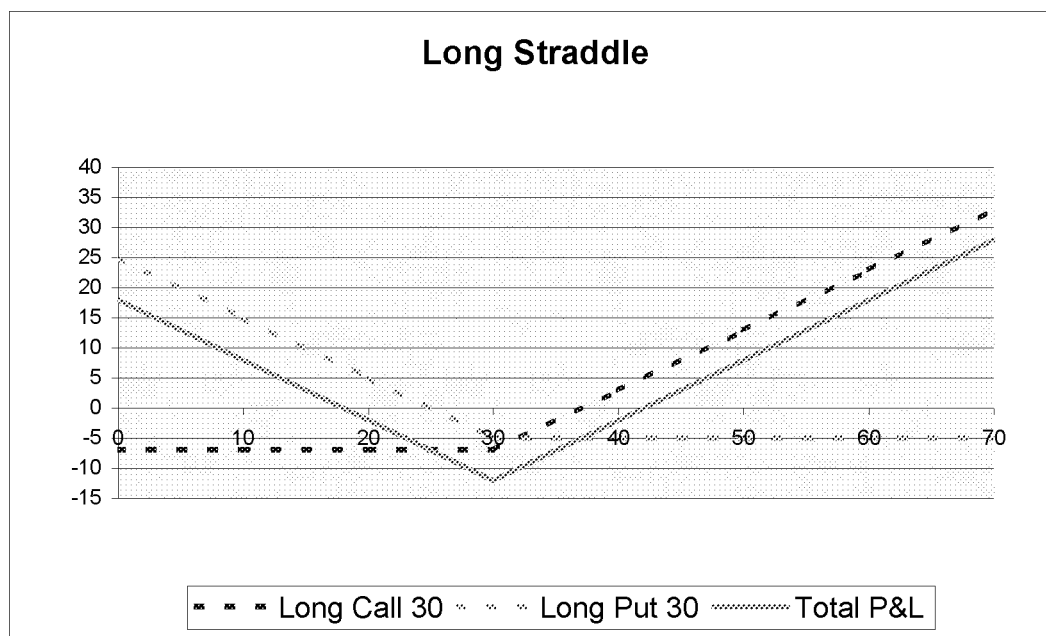
The following graphs illustrate various call/put spreads.





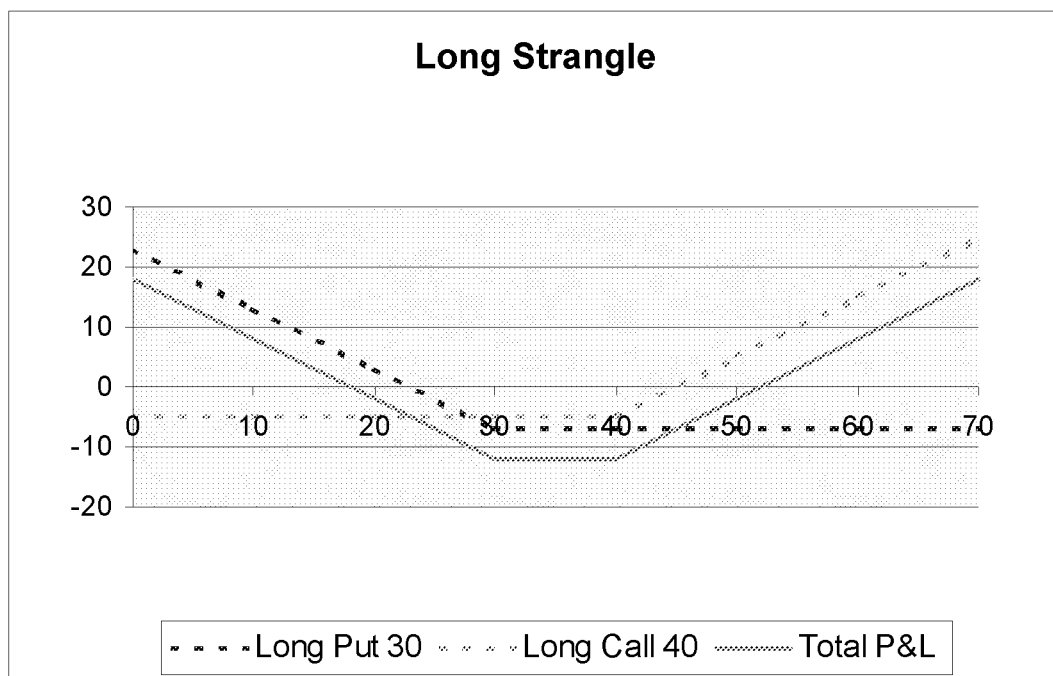
Straddle

A straddle is a combination of a long call and a long put at the same strike price. A long straddle position benefits from volatility, while a short straddle position is short volatility.

**Strangle**

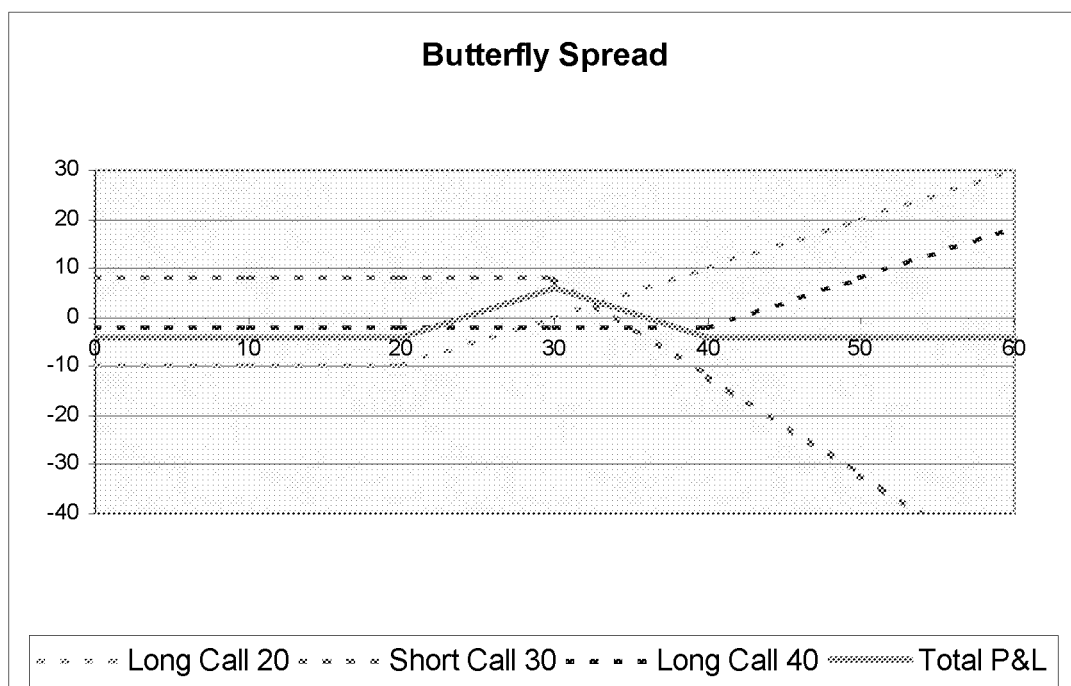
A strangle is the very close cousin of the straddle. Strangles are also a combination of a long call and long put, but at different strike prices. The underlying must have larger moves (or

equivalently, greater volatility) to be profitable. The benefit of a strangle is, all else being equal, that they are cheaper than straddles.



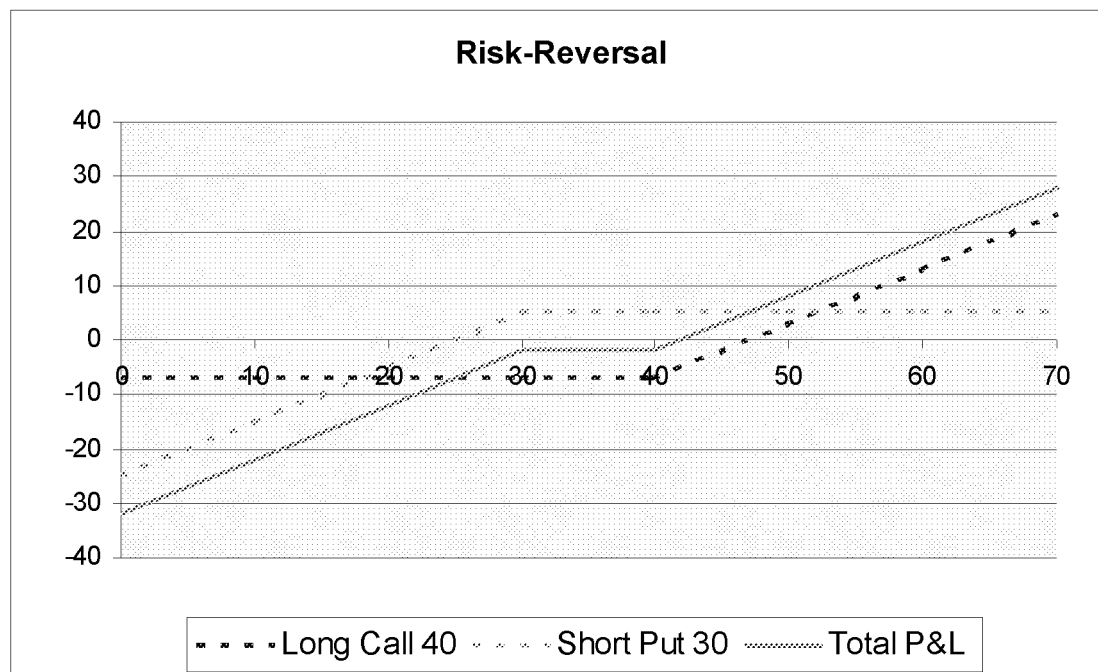
Butterfly Spread

A butterfly spread is a short volatility structure that is similar to a short straddle/strangle with limited downside. We construct the position by purchasing a long option at a high and low strike while selling the midpoint at twice the notional.



Risk-Reversal

The risk-reversal is a combination of a long call and a short put at a lower strike. Risk-reversals are used to quantify the difference between call volatility and put volatility. As discussed earlier, if a trader says, "One month, 25 delta euro calls are 0.80 better bid" this means 25 delta euro calls are trading at a volatility 0.80 higher than the corresponding 25 delta puts.



Other Spreads

There is an infinite set of possible option combinations available to the investor. The above presented some of the more basic and popular trades that are in the market. Familiarizing yourself with these will help in understanding more esoteric structures going forward.

Options Practice Questions:**1. What is the payoff of a call option? of a put? Where are the break-even points?**

Call: Payoff = $\text{Max} \{0, \text{Spot}_{\text{Mat}} - \text{Strike}\}$

Breakeven when $\text{Spot}_{\text{Mat}} = \text{Strike} + \text{Premium}$

Put: Payoff = $\text{Max} \{0, \text{Strike} - \text{Spot}_{\text{Mat}}\}$

Breakeven when $\text{Spot}_{\text{Mat}} = \text{Strike} - \text{Premium}$

2. We can divide the value of an option into two components. They are:

- a. Intrinsic Value – How much the option is “in-the-money”.
- b. Time Value

3. What is time value a function of?

Time value is a function of # days to expiry and volatility.

4. What are the factors that affect the value of an option?

- a. Volatility
- b. Strike
- b. Spot (or forward ... they are highly correlated)
- c. Time
- d. Interest Rates

5. What is the definition of Vega?

Change in option value due to a unit change in volatility of the underlying.

Vega: $\Delta \text{Value} / \Delta \text{Volatility}$

6. You are long a plain vanilla *CALL* option. Are you long or short Delta? Vega? Gamma? Theta?

Delta: You are long Delta. The call option will increase in value when the underlying increases in value. Therefore, your position is equivalent to owning some percentage of a long position in the underlying.

Vega: You are long Vega. Volatility benefits the holder of an option.

Gamma: You are long gamma. By definition, a long option position has positive gamma.

Theta: You are short theta. This is also known as time decay. All else equal, each day that passes your call option value will deteriorate.

7. You are long a plain vanilla *PUT* option. Are you long or short Delta? Vega? Gamma? Theta?

Delta: You are short Delta. The put option will increase in value when the underlying decreases in value. Therefore, your position is equivalent to some percentage of a short position in the underlying.

Vega: Same as question 5.

Gamma: Same as question 5.

Theta: Same as question 5.

8. You are long 10 MM notional of a 2 Month 125.00 USD Call/JPY Put call option. Are you long or short USD/JPY?

You are long USD/JPY. For the option to expire in-the-money, USD/JPY must finish above 125.00.

9. A client just purchased a 28 delta, 50 MM notional of a 1 week 1.6000 USD Call/CAD Put option. This client would like to hedge their delta. Would the client buy or sell USD/CAD to hedge this position? How much?

The client is long a USD/CAD call option. Therefore, they would have a positive delta. To hedge this position they would want to sell USD/CAD.

As for how much, they would sell USD/CAD = Delta * Notional (50MM) = $28 * 50\% = 14.0$ MM.

10. You are long 100 MM notional of a 3 month 126.00 USD Put/JPY Call option. The USD/JPY spot rate is 123.50. Your delta is 75%. What would you do to delta hedge? How much?

Market convention refers to delta as a positive number. A long put option position will always have a negative delta (in the academic sense). You should be able to ascertain this from the fact that you are long a put.

To hedge, you would buy USD/JPY = Delta * Notional = $75\% * 100\text{MM}$
Buy 75 MM USD/JPY.

11. You have the same position as in question 10. Spot moves to 124.00. What has happened to your delta?

Your delta has decreased (moved closer to zero, i.e. 65%).

Deep ITM options have a delta close to 100%.

Deep OTM options have a delta close to 0%.

ATM options have a delta of ~50%.

12. You correctly delta hedged yourself in question 10. However, spot has moved to 122.50 and your new delta is 87%. What action should you take to remain delta neutral? Approximately, how much did your option value change (rough estimate)?

You need to be long 87 MM USD/JPY to be delta hedged. You have already bought 75 MM USD/JPY. You must buy an additional 12 MM USD/JPY. $75 + 12 = 87$.

Roughly, your option increased in value by:
 $75\% * (123.50 - 122.50) * 100 = 75 \text{ MM Yen, or } \sim \$612,250$.

13. The market is short gamma. What could cause this?

The likely cause of this is that the market is short, short-dated options. Especially short-dated ATM options.

14. Your portfolio is long a lot of gamma. However, you believe the market is overpricing gamma. What can you do to capitalize on this view?

You can sell your short-dated ATM options.

15. Your delta is 35% and your gamma is 12%. You are long a call option. Spot moves from 1.0060 to 1.0080. What is your new delta?

Your new delta is equal to: $35\% + 12\% * (20 \text{ pips}) = 35\% + 2.4\% = \underline{37.4\%}$

**Note: Keep in mind delta and gamma are true for small ranges in spot. They change as spot moves.

16. When is Delta the greatest? Vega? Gamma? Theta?

Delta: Delta is greatest (in absolute terms) when an option is deep-in-the money. Deep-in-the-money options behave very much like the underlying.

Vega: Vega is greatest at the money.

Gamma: Gamma is greatest at the money.

Theta: Theta is greatest at the money.

17. How do the following affect the option value?

Factor	Move	Call Value	Put Value
Spot	Increases	Increases	Decreases
Volatility	Increases	Increases	Increases
Time	More days to exp.	Increases	Increases
Strike	Higher strike	Decreases	Increases
Interest Rate	Increase on the base Ccy.	Down on the base Ccy.	Up on the base Ccy.

18. Why is gamma important?

Gamma tells us how sensitive delta is to changes in spot. If we want to remain delta hedged, we must be mindful of our gamma.

19. You think the Yen is over-valued vs. the USD. You also think volatility is overpriced. What option strategy can you use to capitalize on this view?

If you believe volatility is overpriced, you want to sell an option. If you think the Yen is overpriced, you want to sell Yen/buy USD. Therefore, you could sell a USD Put/JPY Call option. If your view is correct, the option will expire worthless and you will pocket the premium.

20. You have 20 MM notional of a EUR Put/USD Call option with a strike of 1.0000 that you paid 12 bips for one month ago. Spot is 0.9975 at expiry. What is your P&L?

Your option has finished 25 pips in-the-money ($1.0000 - 0.9975$). You paid 12 pips, which leaves you 13 pips of profit ($25 - 12 = 13$).

$$\text{Total} = (1.0000 - 0.9975 - 0.0012) * 20 \text{ MM} = 0.0013 * 20 \text{ MM} = \$26,000$$

21. You are long a deep-in-the-money (100% delta) EUR Call/USD Put option with 1 month to expiry. You will sell it in two weeks to get Euros for your new Bentley. Over the next two weeks, you can have one of two things happen:

1. Volatility increases from 7% to 8%
2. Spot increases from 1.0040 to 1.0090

Which would you choose?

You should choose option 2. Deep-in-the-money (100% delta) options are less affected by changes in volatility. In addition, options closer to expiry are less affected by volatility (lower vega). A spot move is more critical for this option's value.

22. You have sold a 100 MM notional of a 1 month EUR/USD 1.0050 strike, 55 delta, EUR call option. Your gamma is 15% and vega is 12 pips. The ECB makes an unexpected announcement that they are going to move rates. Spot remains unchanged. However, vol increases on the news to 9.5% from 8.0%. How much did the value of your option position change by? Has it increased or decreased?

The only factor affecting your option value here is volatility. Spot remained unchanged and we do not know what direction the ECB is going to move (even if we did know, the option value's sensitivity to interest rates, or rho, is a secondary concern).

Vol has increased 1.5% (= 9.5% - 8.0%).

So the option value changes by:

$\text{Vega} = \Delta \text{Value} / \Delta \text{Vol}$, so...

$\Delta \text{Value} = \text{Vega} * \Delta \text{Vol}$

$\text{Vega} * \Delta \text{Vol} = 12 * 1.5 = 18 \text{ pips}$

Since volatility has increased, the value of the call option increases by 18 pips. You are short this option and have lost 18 pips of value.

Total loss = $0.0018 * 100 \text{ MM} = \$180,000$

GLOSSARY

Axe:	Deal a trader needs to execute in order to attain/maintain the position he wants.
Away:	As in “trade away.” For example, customer asks for a price and doesn’t deal with Lehman but with another bank instead. The customer dealt “away.”
OCO:	Order cancels order. The execution of one order cancels another associated order.
American option:	An option that can be exercised at any time during its life.
At-the-money option:	An option in which the strike price equals the price of the underlying asset.
Barrier option:	An option whose payoff depends on whether the path of the underlying asset has reached a barrier (i.e., a certain pre-determined level).
Bear spread:	A short position in a put option with strike price X_1 , combined with a long position in a put option with strike price X_2 where $X_2 > X_1$ (can also be created with call options).
Bull spread:	A long position in a call option with strike price X_1 , combined with a short position in a call option with strike price X_2 where $X_2 > X_1$ (can also be created with put options).
Butterfly spread:	A position that is created by taking a long position in a call with strike price X_1 , a long position in a call with strike price X_3 , and a short position in two calls with strike price X_2 , where $X_3 > X_2 > X_1$ and $X_2 = 0.5(X_1 + X_3)$. (A butterfly spread can also be created with put options).
Calendar spread:	A position that is created by taking a long position in a call option that matures at one time and a short position in a similar call option that matures at a different time (can also be created using puts).
Call option:	An option to buy an asset at a certain price by a certain date.
Combination:	A position involving both calls and puts on the same underlying asset.
Cost of carry:	The storage costs plus the costs of financing an asset minus the income earned on the asset.
Delta:	The rate of change in the price of a derivative with the price of the underlying asset.
European option:	An option that can be exercised only at the end of its life.

Gamma:	The rate of change of delta with respect to the asset price.
Implied volatility:	Volatility implied by the market price of an option. This is calculated by taking the market price of an option, and using the Black-Scholes or a similar model to solve for the volatility necessary to get that price.
LIBOR:	London interbank offer rate. The rate offered by banks on Eurocurrency deposits (i.e., the rate at which a bank is willing to lend to other banks)
Limit order:	An order that can be executed only at a specified price or one more favorable to the investor.
Market maker:	A trader who is willing to quote both bid and offer prices for an asset.
Mark-to-Market:	The practice of revaluing an instrument to reflect the current values of the relevant market variables.
Out-of-the-money option:	Either (a) a call option where the asset price is less than the strike price or (b) a put option where the asset price is greater than the strike price.
Payoff:	The cash realized by the holder of an option or other derivative at the end of its life.
Premium:	The price of an option.
Put option:	An option to sell an asset for a certain price by a certain date.
Range-forward contract:	The combination of a long call and short put or the combination of a short call and long put.
Rebalancing:	The process of adjusting a trading position periodically. Usually the purpose is to maintain delta neutrality.
Reset date:	A date in a swap or cap or floor when the floating rate for the next period is set.
Rho:	The rate of change of the price of a derivative with the interest rate.
Straddle:	A long position in a call and a put with the same strike price.
Strangle:	A long position in a call and a put with different strike prices.
Swap:	An agreement to exchange cash flows in the future according to a pre-arranged formula.
Synthetic Option:	An option created by trading the underlying asset.
Theta:	The rate of change of the price of an option or other derivative with the passage of time.

Up-and-in Option:	An option that comes into existence when the price of the underlying asset increases to a pre-specified level.
Up-and-out Option:	An option that ceases to exist when the price of the underlying asset increases to a pre-specified level.
Vega:	The rate of change in the price of an option with volatility.
Volatility Skew:	A term used to describe the volatility smile when it is nonsymmetrical.
Volatility Smile:	The variation of implied volatility with strike price.