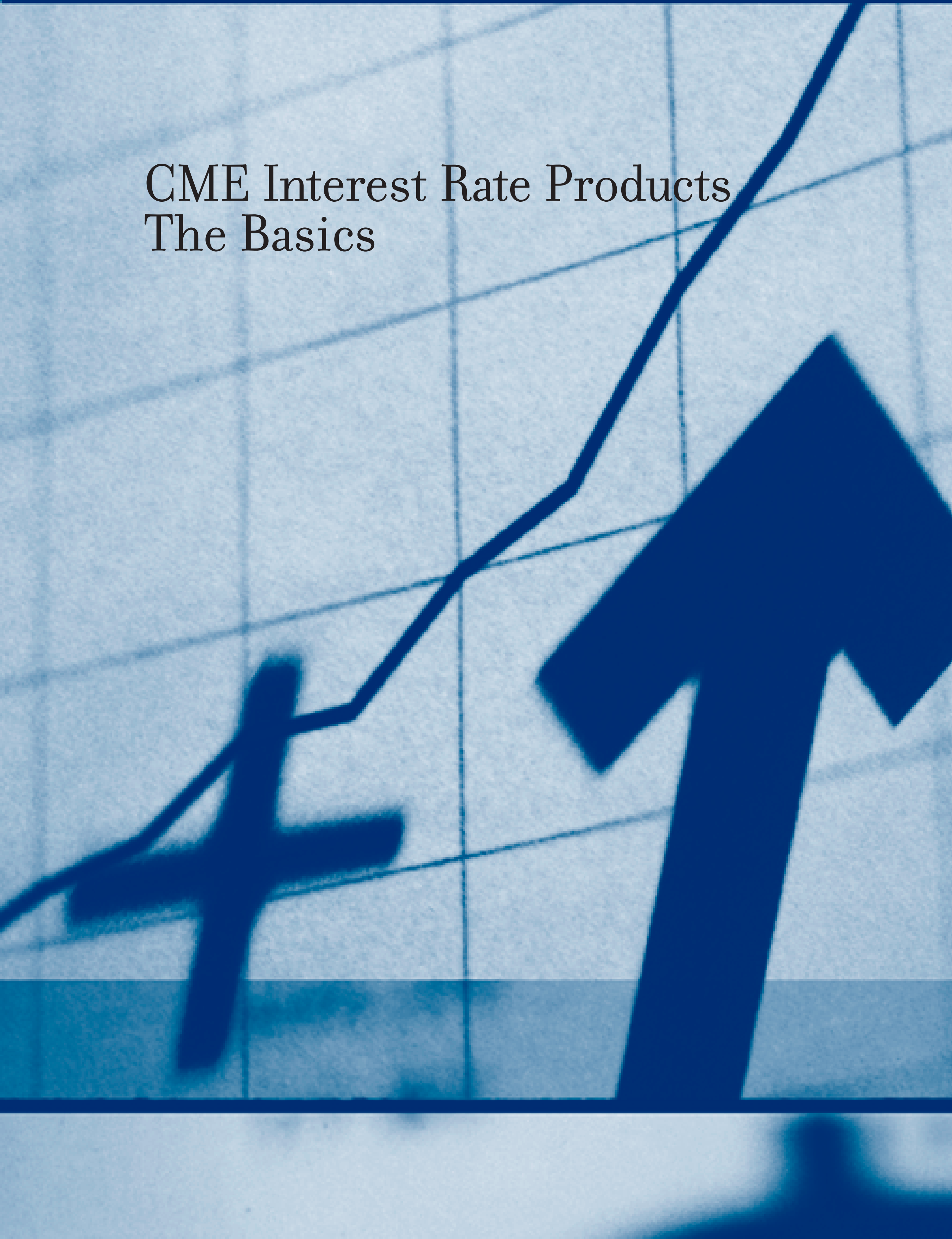
Chicago Mercantile Exchange

CME Interest Rate Products
The Basics



Chicago Mercantile Exchange

Since the introduction of financial futures at Chicago Mercantile Exchange in 1972, the importance of futures in transferring financial risk has been proven by the explosive growth in the market. The vast array of CME interest rate products allows professionals to manage interest rate risks ranging from one month to ten years.

Interest rates, which can be loosely defined as the price of money, affect the livelihoods of individuals and businesses each and every day. The cost of a home mortgage, the finance charge applied to a credit card balance, the amount of interest received on a savings account or the coupon on a corporate bond issue are all examples of the interest rates that influence our personal and commercial activities. Like all goods and services, interest rates are determined by the market forces of supply and demand. However, the federal government also can influence key interest rates via monetary policy, by adjusting rates upward or downward to slow down or stimulate the economy. Interest rate levels often are regarded as key indicators of a country's economic health.

The money market comprises the markets for short-term, heavily traded credit instruments with maturities of less than one year. Money market instruments include Treasury bills, commercial paper, bankers' acceptances, negotiable certificates of deposit, Federal Funds, and short-term collateralized loans. While the markets for these various instruments are distinct, their respective interest rates reflect general credit conditions with adjustments for differences in risk and liquidity.

As the money markets have become more liquid, money managers borrow and lend in whichever markets offer a price advantage. No longer willing to leave balances as unproductive, non-interest-earning demand deposits, corporations today are making more aggressive use of cash management techniques. Cash market participants primarily use CME's interest rate products for pricing and hedging their money market positions.

CME Interest Rate Products

CME lists a variety of contracts on short-term U.S. and foreign interest rates. Here's a brief description of the markets on which the CME products are based:

Three-month Eurodollar Futures
Eurodollars are simply U.S. dollars on deposit in commercial banks outside of the United States. The Eurodollar market has burgeoned over the past 30 years as the dollar has become a world currency. Eurodollar deposits play a major role in the international capital market. The interbank market for immediate (spot) and forward delivery of offshore dollars is deep and liquid, giving banks the ability to fund dollar loans to foreign importers without incurring currency exchange risks.

Eurodollar deposits are direct obligations of the commercial banks accepting the deposits. They are not guaranteed by any government. Although they represent low-risk investments, Eurodollar deposits are not risk-free.

CME's Eurodollar time deposit futures contract reflects the London Interbank Offered Rate (LIBOR) for a three-month, $1 million offshore deposit. A total of 40 quarterly futures contracts, spanning ten years, plus the four nearest serial (non-quarterly) months are listed at all times. Eurodollar futures are the cornerstone of the Exchange's interest rate quadrant and are the most liquid exchange-traded contracts in the world when measured in terms of open interest.

One-month LIBOR (London Interbank Offered Rate) Futures
LIBOR is a reference rate for dealing in Eurodollar time deposits between commercial banks in the London Interbank Market. LIBOR often is the benchmark rate for commercial loans, mortgages, and floating rate debt issues. CME's LIBOR contract is analogous to the Eurodollar contract, but represents one-month LIBOR on a $3 million deposit. The Exchange currently lists twelve consecutive monthly LIBOR futures at any given time.

13-Week Treasury Bill Futures
As direct obligations of the U.S. government, Treasury bills are considered risk-free debt instruments and provide the foundation for the money markets because of their unique safety and liquidity. Because of their risk-free nature, changes in the yield on T-bills reflect "pure" interest rate movements.

Euroyen Futures
Analogous to Eurodollars, Euroyen are Japanese 3-month yen deposits outside Japan. Like the dollar, the Japanese yen is globally traded on a 24-hour-a-day basis. There are two 3-month Euroyen futures contracts offered by the CME; one settles to Euroyen TIBOR (Tokyo Interbank Offered Rate) and the other to Euroyen LIBOR (London Interbank Offered Rate). This gives hedgers even greater latitude in managing their risk in short-term Japanese yen deposit rates and swaps. CME's Euroyen futures are fully fungible with the Euroyen TIBOR and Euroyen LIBOR contracts traded on the Singapore Exchange (SGX). Via the Mutual Offset System with the SGX, open positions may be held either in Chicago or Singapore.

Swap Futures
In order to provide investors involved in U.S. dollar denominated swaps with new trading and hedging opportunities, CME offers 2-, 5-, and 10-year Swap futures. These exchange-traded derivatives are priced in the traditional CME IMM fashion—like the Exchange's flagship Eurodollar futures—of 100 minus the 2-, 5-, or 10-year swap rate and settle to the International Swaps and Derivatives Association (ISDA) benchmark swap survey interest rate. The Swaps contract provides investors with a hedging vehicle that better tracks the underlying cash U.S. dollar swap market. It is also readily available for traders to spread against Eurodollar futures and options—the world's most actively traded and liquid interest rate contracts. The 2-year Swap futures have a notional value of $500,000, the 5-year contract has a notional value of $200,000, and the 10-year contract has a notional value of $100,000. The value of one basis point in each maturity is $100, and the minimum trading increment is ¼ of one basis point or $25.00.

The CME-SGX Mutual Offset System (MOS)
In 1984, Chicago Mercantile Exchange, in partnership with the Singapore Exchange (SGX), pioneered an innovative approach to futures trading known as the Mutual Offset System (MOS). Through the MOS, contracts opened on one exchange can be liquidated or held at the other. The CME-SGX link effectively extends the trading hours of both exchanges beyond their operating hours, allowing traders to better manage their overnight risk. This agreement, the first international futures trading link of its kind, is available for both Eurodollar and Euroyen futures.

For a more detailed description of the CME/SGX Mutual Offset System, please consult the CME Web site at www.cme.com.

Interest Rate Futures Contract Months
Eurodollar, LIBOR, and T-bill contracts are listed for all calendar months. Swap futures and Euroyen contracts are on a "March quarterly cycle"—March, June, September and December. Many traders are familiar with the March quarterly cycle, but those months which are not in that cycle are referred to as "serial" expirations—January, February, April, May, July, August, October and November. A contract month identifies the month and year in which the futures or options contract ceases to exist. It is also known as the "delivery month." This procedure ensures that the futures price converges with the cash market price. However, the vast majority of market participants close out their positions before expiration by establishing new positions in the next month or rolling their positions forward. In fact, only a very small percentage of futures transactions reach delivery. However, it is important to note that all of the interest rate products discussed in this publication are "cash settled" without any physical delivery.

Interest Rate Futures Basics
CME interest rate futures contracts are traded using a price index, which is derived by subtracting the futures' interest rate from 100.00. For instance, an interest rate of 5.00 percent translates to an index price of 95.00 (100.00 – 5.00 = 95.00). Given this price index construction, if interest rates rise, the price of the contract falls and vice versa. Therefore, to profit from declining interest rates, you would buy the futures contract (go long); to profit from a rise in interest rates, you would sell the contract (go short). In either case, if your view turns out to be correct, you will be able to liquidate or offset your original position and realize a gain. If you are wrong, however, your trade will result in a loss.

The design of CME interest rate futures contracts feature prices denominated in ¼, ½ or 1 basis point increments; those in the market refer to this as the "tick" or basis point value. Gains or losses, therefore, are calculated simply by determining the number of ticks moved, multiplied by the value of the tick. A full tick or basis point in the 3-month Eurodollar futures is worth $25.00. Below, we can see the origin of the $25.00 basis point value based on the $1,000,000 notional value of this contract:

$$\$25.00 = \$1{,}000{,}000 \text{ notional value} \times .0001 \text{ basis point} \times 90/360 \text{ deposit period}$$

For the nearest expiring or "spot" month in 3-month Eurodollar futures (serial or quarterly) and 1-month LIBOR futures, the minimum price fluctuation is ¼ of a basis point or $6.25. For all other 3-month Eurodollar, 1-month LIBOR and all 13-Week Treasury Bill contracts the minimum price fluctuation is ½ of one basis point or $12.50. For both the Euroyen TIBOR and Euroyen LIBOR Japanese yen denominated contracts, the minimum price fluctuation is ½ of one basis point or ¥1,250.

Hedging with Interest Rate Futures

Interest rate futures can be used to hedge against an existing or future interest rate risk. This is accomplished by maintaining a futures position that will generate profits to cover (or offset) the losses associated with an adverse move in interest rates. It is important to note that a properly constructed futures hedge can also generate losses that will offset the effects of a beneficial interest rate move. In addition, because futures are quoted in terms of price rather than interest rate, futures exhibit an inverse relationship between rates and price. A borrower would sell futures to protect against an interest rate rise, i.e., to profit from a decrease in the futures price, and a lender would buy futures to hedge against an interest rate decline or capitalize on an increase in the futures price. Consider these examples:

Hedging a Forward Borrowing Rate

In late September a corporate treasurer projects that cash flows will require a $1 million bank loan on December 16. The contractual loan rate will be 1% over the three-month Eurodollar (LIBOR) rate on that date. LIBOR is currently at 5.56%. The December Eurodollar futures, which can be used to lock in the forward borrowing rate, are trading at 94.24, implying a forward Eurodollar rate of 5.76% (100.00 – 94.24). By selling one December Eurodollar futures contract, the corporate treasurer ensures a borrowing rate of 6.76% for the three-month period beginning December 16. This rate reflects the bank's 1% spread above the rate implied by the futures contract.

For another detailed example of how you can create a synthetic fixed rate loan with Eurodollar futures, see Appendix A.

Modifying Maturities

With either assets or liabilities, hedging can serve as an alternative to restructuring the portfolio in the cash markets. Asset managers can lengthen the effective maturity of short-term investment assets by buying futures contracts, or shorten the effective maturity by selling futures. Assume a lender places $1 million in a three-month time deposit at 5% in September. After some time, the lender believes that rates will decline in the coming months and wants to extend the duration of the loan out to six months. At this time, the lender can purchase a December Eurodollar futures contract, thereby synthetically extending the duration of the loan. Liability managers can achieve the same effects by doing the opposite, i.e., selling futures to lengthen their liabilities and buying futures to shorten them.

The use of futures may be an attractive alternative when physical restructuring is not possible; for example, term deposits cannot be bought back prior to their maturity dates. It also may be less expensive to use futures because transaction costs may be lower than those in cash markets, or liquidity conditions in the cash market would result in substantial market penalties.

Swapping Fixed and Floating Rates

Many interest rate swap dealers incorporate CME interest rate futures into their portfolios to hedge and/or arbitrage their money market swaps. One of the most common uses of Eurodollar futures is to convert a floating interest rate exposure to a fixed rate, or vice versa. When using futures contracts as part of a swap transaction, it is important to note that futures cover single interest periods only, whereas swaps are multi-period instruments. To hedge between futures and swaps then, it is necessary to transact a strip, i.e., a coordinated purchase or sale of a series of futures contracts with successive expiration dates.

Locking in a Funding Rate

Consider the case of a bank that funds itself with three-month Eurodollar Time Deposits at LIBOR. Let's assume this bank has a customer who wants a one-year, fixed-rate loan of $10 million, with interest to be paid quarterly. At the time of the loan disbursement the banker raises three-month funds at 5.75%, but has to roll over this funding in three successive quarters. If he does not lock in a funding rate and interest rates rise, the loan could prove to be unprofitable.

The three quarterly re-funding dates fall shortly before the next three Eurodollar futures contract expirations in March, June, and September. At the time the loan is made, the price of each contract is 94.12, 93.95, and 93.80, corresponding to yields of 5.88%, 6.05%, and 6.20%, respectively. Coupled with the initial funding rate of 5.75%, the bank could lock in a cost of funds for the year equal to 6.11%.*

*[((1+ .0575 x 91/360) x (1+.0588 x 91/360) x (1+.0605 x 91/360) x (1+.0620 x 91/360) - 1) x 360/364 ≈ 6.11%]

The banker knows that the money needed to fund the loan can be locked in for a year at approximately 6.11% in the futures market. This rate can be used as a basis for quoting the fixed rate to the customer. Generally speaking, the rate quoted will cover hedging expenses and allow a profit margin.

If the loan is made and the risk is hedged in the futures market, the banker would sell 10 contracts for each expiration, reflecting the funding need of $10 million per quarter. Then, on the refinancing dates, the banker would take in three-month Eurodeposits and simultaneously liquidate the appropriate hedging contracts by buying them back. With the March refunding, the March contracts would be liquidated; June contracts would be liquidated in June; and September contracts would be liquidated in September.

In this scenario, the banker is able to re-fund at 7.00%, 7.15%, and 7.35% for the respective quarters. The corresponding futures are liquidated at 92.98 (7.02%), 92.80 (7.20%), and 92.66 (7.33%). The overall results are shown below.

Quarterly Eurodollar Deposit Costs

Q1:	$10 million x .0575 x 91/360 =	$145,347	
Q2:	$10 million x .0700 x 91/360 =	$176,944	
Q3:	$10 million x .0715 x 91/360 =	$180,736	
Q4:	$10 million x .0735 x 91/360 =	$185,792	
		$688,819	(6.89%)

Less the futures profits

MAR:	10 contracts x (9412 - 9298) x $25 =	$28,500	
JUN:	10 contracts x (9395 - 9280) x $25 =	$28,750	
SEP:	10 contracts x (9380 - 9266) x $25 =	$28,500	
Futures gain		($85,750)	(0.86%)
Total interest expense		$603,069	
Effective rate			6.03%

The unhedged interest expense over the four quarters would have been 6.89%, substantially higher, in fact, than the hedged expense. It should be recognized that effective futures hedges materially lock in an interest rate, precluding both advantage and loss from rate movement. Had interest rates moved lower over the life of the hedge, the bank would have incurred an opportunity cost roughly equal to the difference between the effective (hedged) rate and the lower rate which could have been realized by forgoing the use of futures.

Recall that the banker had expected to lock up funding at 6.11%. In fact, funds were acquired at 6.03%, or approximately eight basis points lower. This discrepancy occurred because of less-than-perfect convergence between the cash re-funding rates and the futures liquidation rates. If the bank had funded at exactly the same rate as the futures liquidation rate, the target would have been achieved. In this case, however, the actual funding over the term of the loan was, on average, lower than the futures liquidation rates. Put another way, these basis adjustments positively affected the performance.

The minimal difference between the target rate and the effective funding rate can be attributed to the fact that the re-funding dates were quite close but not identical to the futures expiration dates. If the respective dates were further apart, the funding rates and the futures rates would not necessarily converge as closely as those used in the above example.

This example of a one-year loan funded with three-month deposits illustrates a negative interest rate "gap"– that is, where shorter-term liabilities are funding a longer term asset, and rising interest rates will have an adverse impact. The same basic hedging approach can be followed to remedy an overall balance sheet maturity mismatch.

Eurodollar Futures: Bundles and Packs

To expedite the execution of strip trades (trades involving multiple consecutive contracts), CME offers Bundles and Packs for Eurodollar futures. Bundles and Packs are simply "pre-packaged" series of contracts that facilitate the rapid execution of strip positions in a single transaction rather than constructing the same positions with individual contracts.

Bundles
Eurodollar Bundles allow traders to simultaneously buy or sell a consecutive series of Eurodollar futures in equal proportions beginning with the front quarterly contract. This means that, for example, a 5-year "strip" comprised of 20 individual contracts can be executed with just one transaction. Currently 1-, 2-, 3-, 4-, 5-, 6-, 7-, 8-, 9-, 10-, and 5-year forward Bundles are available, as well as "Rolling" Packs and Bundles which can be constructed starting with any quarterly contract.

Eurodollar Bundles are quoted in ¼-basis-point (.25) price increments. Whole-basis-point prices are assigned to individual legs of the Bundle consistent with the traded price. Prices are assigned according to an Exchange-approved pricing convention.

Packs
Eurodollar Packs are the simultaneous purchase or sale of an equally weighted, consecutive series of four Eurodollar futures, quoted on an average net change basis from the previous day's close.

Packs, like Eurodollar futures, are designated by a color code that corresponds to their position on the yield curve. There are generally nine Packs trading at a given time: Red, Green, Blue, Gold, Purple, Orange, Pink, Silver, and Copper, corresponding to Eurodollar futures years 2-10, respectively

Eurodollar Packs are quoted in ¼-basis-point (.25) price increments. Whole-basis-point prices are assigned to individual legs of the Pack consistent with the traded price. Prices are assigned according to an Exchange-approved convention. For example, if a pack (four quarterly Eurodollar expirations) is down 2.25 ticks, then individual contracts will be -2, -2, -2, and -3.

Eurodollar Color Codes for Individual Year Strips:

COLOR	YEAR	CONTRACTS
White	One	1-4
Red	Two	5-8
Green	Three	9-12
Blue	Four	13-16
Gold	Five	17-20
Purple	Six	21-24
Orange	Seven	25-28
Pink	Eight	29-32
Silver	Nine	33-36
Copper	Ten	37-40

Final Settlement Procedures

CME's interest rate futures are much like over-the-counter Forward Rate Agreements (FRAs) in that delivery of the face value of the contract never occurs. All CME interest rate futures are cash-settled upon expiration.

Long and short positions are simply marked to a final settlement price. The following are final settlement procedures for the CME's interest rate contracts.

CONTRACTS	LAST TRADE DATE / FINAL SETTLEMENT
3-month Eurodollar Futures	Second London bank business day prior to the third Wednesday of the contract month. Cash settlement to British Bankers' Association survey of 3-month LIBOR. Final settlement price will be rounded to four decimal places, equal to 1/10,000 of a percent, or $0.25 per contract.
1-month Libor Futures	Second London bank business day prior to the third Wednesday of the contract month. Cash settlement to the British Bankers' Association survey of 1-month LIBOR. Final settlement price will be rounded to four decimal places, equal to 1/10,000 of a percent, or $0.25 per contract.
2-, 5-, & 10-Year Swap Futures	Second London bank business day prior to the third Wednesday of the contract month. Based on rates for 2-year, 5-year and 10-year U.S. Dollar Benchmark Swap rates quoted by International Swaps and Derivatives Association (ISDA) on last trading day.
13-Week T-Bill Futures	12:00 noon Chicago time on the business day of the 91-day U.S. Treasury bill auction which occurs during the week of the third Wednesday of the contract month . Cash settlement to 100 minus the highest discount rate accepted in the U.S. Department of the Treasury's 91-day U.S. Treasury bill auction in the week of the third Wednesday of the contract month.
3-Month Euroyen (TIBOR & LIBOR)	The third business day immediately preceding the third Wednesday of the contract month. TIBOR — Cash settlement to the same final settlement price used by the Singapore Exchange (SGX). The SGX settlement price is based on the offered rate for 3-month yen deposits as determined by the Tokyo International Financial Futures Exchange (TIFFE), two business days prior to the third Wednesday of the contract month. LIBOR — Cash settlement to the same final settlement price used by SGX. The SGX settlement price is based on the 3-month London Interbank Offered Rate (LIBOR) as determined by the British Bankers' Association survey on the second London bank business day immediately prior to the third Wednesday of the contract month.

Options on Interest Rate Futures

Options on interest rate futures provide the opportunity to limit losses while maintaining the possibility of profiting from a favorable move in rates. Options are analogous to an insurance policy—the option buyer pays a price or premium in return for the right to buy (call) or sell (put) a futures contract, within a stated period of time, at a predetermined price known as the strike (or exercise) price. If the price of the underlying futures contract never reaches a level that makes it profitable for the option buyer to exercise his/her right, the option expires worthless.

All CME interest rate options are American-style, meaning that the options may be exercised on or before expiration. When taking an option position by purchasing a call or put, a performance bond (margin) is not required because the price paid on the option, also referred to as the option premium, is the maximum loss that can be incurred by a long option position.

CME lists options on 3-Month Eurodollars, 1-Month LIBOR, and Euroyen TIBOR futures (Euroyen options are not eligible for mutual offset). Mid-curve options, which are short-dated, American-style options on long-dated Eurodollar futures, also are listed. These options have as their underlying instrument Eurodollar futures contracts one and two years out. Because the options are short-dated, they offer a low-premium, high-time-decay alternative in this segment of the yield curve.

Options on Eurodollar Futures
CME currently offers three different types of options on Eurodollar futures: Quarterly, Serial and Mid-Curve.

Quarterly

UNDERLYING CONTRACT:	Corresponding futures contract
CONTRACT MONTHS:	Mar, Jun, Sep, Dec
NUMBER LISTED:	8
LAST TRADING DAY:	11:00 a.m. London time on the second London bank business day preceding the third Wednesday of the contract month
SETTLEMENT/EXERCISE:	Cash-settled

Serial

UNDERLYING CONTRACT:	Next quarterly futures contract
CONTRACT MONTHS:	Jan, Feb, Apr, May, Jul, Aug, Oct, Nov
NUMBER LISTED:	2
LAST TRADING DAY:	2:00 p.m. Chicago time on the Friday preceding the third Wednesday of the contract month
SETTLEMENT/EXERCISE:	Position in front quarterly futures contract

Mid-Curve

UNDERLYING CONTRACT:	Quarterly Eurodollar future that expires one or two years after the option
CONTRACT MONTHS:	All twelve calendar months for one-year Mid-Curves and Mar, Jun, Sep, Dec for two-year Mid-Curves
NUMBER LISTED:	2 serial and 4 quarterly in the one-year Mid-Curve and 4 quarterly in the two-year Mid-Curve
LAST TRADING DAY:	2:00 p.m. Chicago time on the Friday preceding the third Wednesday of the contract month
SETTLEMENT/EXERCISE:	Quarterly options: Position in the corresponding futures contract expiring either one or two years after the option expires. Serial options: Position in the next quarterly futures contract expiring one year after the option expires.

A Glossary of Options Terms
Call: Gives the holder the right to buy a futures contract at the strike price

Put: Gives the buyer the right to sell a futures contract at the strike price

Strike: The price at which the underlying futures contract will be bought (in the case of calls) or sold (in the case of puts)

Intrinsic Value: The amount the futures price is higher than a call's strike; or the amount the futures price is below a put's strike.

Time Value: The part of the option price that is not intrinsic value

At-the-money: An option is said to be "at-the-money" when the underlying futures price is equivalent to the option strike price.

In-the-money: An option is said to be "in-the-money" when the underlying futures price is greater than a call option's strike price or less than a put option's strike price.

Out-of-the-money: An option is said to be "out-of-the-money" when the underlying futures price is less than a call option's strike price or greater than a put option's strike price.

Delta: A measurement of the rate of change of an option premium with respect to a price change in the underlying futures contract. Delta is always expressed as a number between −1 and +1.

Prices of Interest Rate Options
CME interest rate option prices are quoted in terms of index points rather than a dollar value. Because the futures price, options price and strike price are quoted in the same terms, the price relationships are clearly observable. The price of an option is shaped by the following factors:

1. **Option strike price versus the current underlying futures price:** As a rule of thumb, the closer an out-of-the-money option is to being at-the-money, the higher the option price. For in-the-money options, the more an option is in-the-money, the greater its value and thus, price.

2. **Time to expiration:** Premiums on options with a greater time to expiration tend to be higher than those that are close to expiring. This occurs because a longer time period provides more opportunity for the option to expire "in-the-money."

3. **Market volatility:** Generally, the greater the volatility of the underlying futures price, the more valuable the option.

To determine how much an interest rate option premium is in dollar terms, simply take the stated price, for example 1.32 points, and multiply by $2,500. Or, think of it in terms of 132 ticks times $25 per tick. In either case, the premium equals $3,300.

Hedging with Options on Interest Rate Futures

Whenever Eurodollar or LIBOR can be used to lock in a rate, options on futures can be substituted to guarantee a rate floor or ceiling. As an alternative to a long futures position, which determines a forward investment return for an asset, the purchase of a call option can be substituted. The call gives the right to buy the futures contract at a stated price, providing a floor for a return on the asset while preserving the opportunity for a potential profit.

On the other hand, instead of taking a short futures position to predetermine a liability rate, buying a put option can provide protection. The put gives the right to sell the futures at a stated price, providing a ceiling for the liability rate, while preserving the opportunity for a lower cost of funds.

The effective floor or ceiling rate provided by the option is determined by its strike price and the premium paid. The "strike yield" (simply 100 minus the option strike price) is adjusted to reflect the cost of the option. For example, suppose the following prices were observed:

CONTRACT	PRICE/PREMIUM	DELTA
Dec Eurodollar futures	94.24	1.00
Dec 94.25-strike call	0.12	0.49
Dec 94.50-strike call	0.025	0.22
Dec 94.25-strike put	0.13	0.51
Dec 94.00-strike put	0.05	0.23

Under these conditions, the user of the futures contract could expect to lock in a target LIBOR of 5.76 percent (100.00 – 94.24) — an asset return if long or a liability cost if short. Subject to basis risk, this yield would be locked in regardless of whether market rates rise or fall over the hedge period.

Using the 94.25-strike call to hedge a floating rate investment, a hedger could guarantee a minimum return of 5.75 percent for a cost of 12 basis points. In other words, the realized minimum return would be 5.63 percent as a worst case (5.75 – .12).

If the rate falls below 5.75 percent, futures prices would rise and the call option would increase in value. The lower investment rate on the asset would be supplemented by the profit on the call to ensure a minimum net return of 5.63 percent. On the other hand, if the rate rises above 5.75 percent, the option would be worthless at expiration, and the investor would simply lose the cost of the option and receive the higher market rate on the asset.

Using the 94.50-strike call, the investment hedger would establish a minimum return of 5.475 percent (100.00 – 94.50 – .025). Why would someone use the 94.50-strike call rather than the 94.25-strike call, when the latter offers a higher minimum return? The question involves an important tradeoff consideration.

While it is true that the 94.25-strike call provides a more attractive worst-case scenario, it does so for a larger upfront cost. The purchaser of the 94.25-strike call pays $300 for this protection ($25 x 12 basis points), while the cost of the 94.50-strike call is only $62.50 ($25 x 2.5 basis points).

To hedge floating rate liabilities, put options present a similar set of choices. A short futures contract can establish a forward rate of 5.76 percent. The 94.00-strike put can provide a ceiling rate of 5.95 percent (100.00 – 94.00 – .05) for the premium of $125 ($25 x 5 basis points); and the 94.25-strike put can provide a 5.62 percent (100.00 – 94.25 – .13) ceiling rate for the price of $325 ($25 x 13 basis points).

How to Read Interest Rate Prices

Finding futures and options prices is fairly easy. But how do you decipher what you see or hear? Although the amount of information published by a source often differs, all the information will look something like Tables 1 and 2.

Table 1 **Futures**

Eurodollar (CME) - $1,000,000; pts of 100%

	OPEN	HIGH	LOW	SETTLE	CHANGE	YIELD SETTLE	CHANGE	OPEN INTEREST
Nov	98.22	98.23	98.20	98.20	-.03	1.80	.03	52,832
Dec	98.25	98.26	98.22	98.22	-.03	1.78	.03	849,357
Mar	98.14	98.19	98.10	98.10	-.06	1.90	.06	659,834
Jun	97.89	97.96	97.81	97.82	-.10	2.18	.10	489,931

Est vol 621,839; vol Fri 805,458; open int 4,202,560, +13,136

Table 2 **Options**

Eurodollar (CME) - $1,000,000; pts of 100%

STRIKE	CALLS-SETTLE			PUTS-SETTLE		
PRICE	NOV	DEC	MAR	NOV	DEC	MAR
9775	...	4.82	0.457	...	0.07	0.105
9800	...	2.50	0.29	0.10	0.25	0.185
9825	0.65	1.00	0.175	0.90	1.25	0.32
9850	0.17	0.40	0.095	2.92	3.15	0.487
9875	0.05	0.15	0.05	...	5.40	0.692
9900	...	0.10	0.025	...	7.82	

Est vol 203,741; Fri vol 147,138 calls, 92310 puts; Open int Fri 5,131,163 calls, 3,576,296 puts

Terms Used in Reporting Interest Rate Prices

In the daily newspaper listings, the tables reflect the previous day's prices. Open interest figures are published on a two-day lag. Here are some of the terms you'll need to know to read the tables.

Open: The average price at which the first bids and offers were made or the first transactions were completed.

High: Top bid or top price at which a contract was traded during the trading period.

Low: Lowest offer or the lowest price at which a contract was traded during the trading period.

Settlement price: The official daily closing price, typically set at the midpoint of the closing range.

Net change: The amount of increase or decrease from the previous trading period's settlement price.

Yield settlement: The interest rate implied by the settlement price

Yield change: One day's change in the futures' interest rate–equal and opposite to change the in settlement price

Volume: The number of contracts traded (one side of each trade only) for each delivery month during the trading period.

Open interest: The accumulated total of all currently outstanding contracts (one side only). Refers to unliquidated purchases and sales.

Strike price: The price at which the buyer of a call (put) option may choose to exercise the right to purchase (sell) the underlying futures contract. Also known as exercise price.

Put: The right, but not the obligation, to sell a futures contract at the option's strike price on or before the expiration date.

Call: The right, but not the obligation, to buy a futures contract at the option's strike price on or before the expiration date.

Appendix A:

The Synthetic Fixed Rate Loan: *An Illustration*

The Situation

To fund a capital investment project, ABC Company requires a $10 million bank borrowing for one year. The company has a standing arrangement with its primary banker whereby it can borrow this amount at the then current three-month LIBOR rate (i.e., the London Interbank Offered Rate on U.S. dollars on deposit outside the United States) for individual three month periods. Thus, under the banking arrangement, borrowing rates are reset quarterly and interest payments are due quarterly. ABC Company's Treasury Department forecasts a rising rate environment over the next year. As a result, it prefers not to reset the rate on the $10 million loan at three-month intervals to the then current (and anticipated higher) LIBOR rate. Instead, it wants a fixed rate loan of one year duration. The corporate treasurer considers two alternate ways to effectively borrow one year fixed: (1) simply asking the company's banker for terms for a one-year, fixed rate loan or (2) employing the current standing loan arrangement where $10 million can be borrowed for three month periods throughout the year at the prevailing three -month LIBOR rate and, at the same time, "synthetically" fixing the additional three forward borrowing rates via the Chicago Mercantile Exchange's (CME) Eurodollar time deposit futures contract. By overlaying short futures positions onto the cash market loan arrangement, the treasurer can effectively create a synthetic one-year, fixed-rate loan. How might the treasurer evaluate the two alternatives?

Evaluation and Setting Up the Hedge

The treasurer compares the one-year loan rate offered by the banker to the comparable one available in the futures market. To synthetically create a one-year fixed rate loan, the treasurer borrows from his banker for three months at the three-month LIBOR rate (as specified by the standing banking arrangement) and simultaneously sells futures contracts in the succeeding three contract months. The treasurer sells a "strip" of futures contracts in this example because he expects to take down the $10 million loan on December 15. Thus, he will borrow from his banker for a three-month period at the three-month LIBOR rate available on December 15. In addition, ten March, ten June and ten September futures contracts would simultaneously be sold. These futures contracts are sold in order to hedge against LIBOR rates rising by the time the quarterly loan rates are to be reset, namely on March 15, June 15 and September 15. The March contracts are sold to protect against interest rates rising between December 15 and March 15 of the following year; the June contracts are sold to eliminate rate exposure for the December 15 to June 15 period; and the September futures are sold to offset the rate increases which might occur from December 15 through September 15.

Why sell futures contracts as opposed to buying them? The treasurer sells the futures contracts to eliminate exposure associated with rising rates. If rates rise, the prices of Eurodollar futures contracts fall. Having previously sold the contracts, the treasurer can liquidate the futures market positions by buying them back at lower prices. Thus, the gain on the futures positions will help neutralize the "loss" sustained in the cash market (i.e., the "loss" associated with having to pay higher loan rates).

Why are ten contracts of each of three futures contract months sold when only $10 million dollars is at risk? The simple answer is that the Eurodollar futures contract is based on a $1,000,000 three-month time deposit, and if the company wishes to fix borrowing costs for an additional nine months, three futures contracts (in this case, the March, June and September contracts) for each $1 million are needed. Equalizing dollar amounts ($10,000,000) between the cash and futures markets by selling just ten contracts would lock in rates for only three months. By analogy, 30 contracts would lock in rates for nine months. In this instance ten contracts are used for each three-month period of coverage desired.

Exhibit 1 illustrates the synthetically produced one-year rate the treasurer could "lock in" on December 15. The loan rate available via the combination of the standing borrowing arrangement and the futures positions is 2.42% target rate is derived by taking a simple average of the 3-month LIBOR rate plus the strip of futures rates prevailing on December 15 for the March, June and September contracts. This is the rate the treasurer expects to lock in for the synthetic one-year, fixed rate loan.

Exhibit 1 **Setting the Loan Rate**

Rate = Average of the current 3-month LIBOR rate plus strip of futures

	RATES	
3-month deposits	1.89%	
Mar Futures	2.08%	(97.92)
Jun Futures	2.54%	(97.46)
Sep Futures	3.18%	(96.82)
Average rate	*2.42%*	

Given this "wholesale," synthetically produced rate, the treasurer can then ask his banker for the comparable "retail" rate. If the banker offers a one-year fixed borrowing rate, which is close to the 2.42%, there is little incentive to enter the futures market. Instead, the treasurer would simply borrow for one year from the bank. If, however, the rate quoted by the bank were substantially higher than the rate available via the combination of three-month LIBOR plus the strip of futures contracts, the treasurer would likely choose to create the fixed-rate loan synthetically.

The Hedge and the Results

Let's investigate what would have happened in this instance if the retail rate offered by the bank had been relative to the wholesale rate and, as a result, the futures route had been chosen. Exhibit 2 outlines the cash market history over the life of the one-year loan period.

Exhibit 2 **Cash Market History**

DATE	PRINCIPAL X	LIBOR (LOAN) RATE X	TERM =	INTEREST EXPENSE
Dec 15	$10 million	1.89%	90/360 days	$47,250
Mar 15	$10 million	2.44%	90/360 days	$61,000
Jun 15	$10 million	2.75%	90/360 days	$68,750
Sep 15	$10 million	2.90%	90/360 days	$72,500
Simple Average		*2.50%*		

Had the treasurer simply maintained the standing bank loan arrangement, where money is borrowed at the three-month LIBOR rate for three month periods, these are the rates and dollar amounts of interest that would have been paid on the four quarterly $10 million borrowings. Had the treasurer borrowed for three month periods without hedging via the futures market, the 1.89%, 2.44%, 2.75% and 2.90% borrowing rates would have been paid. Taking a simple average of these rates, the treasurer would have paid an all-in rate of 2.50% on the one-year bank borrowing. What would have happened had the treasurer taken advantage of the standing loan arrangement and, in addition, hedged the resultant rate exposure with futures? As shown in Exhibit 3, on December 15 the treasurer borrows from his bank at the three-month LIBOR rate for the period December 15-March 15. Simultaneously on that date, the treasurer sells 10 March Eurodollar futures contracts at a price of 97.92 (i.e., implying a rate of 2.08% for the mid-March to mid-June period), 10 June contracts at 97.46 and 10 September contracts at 96.82.

Exhibit 3 **Futures Market History**

DEC 15: Sell 10 Mar @ 97.92 (2.08%)
Sell 10 Jun @ 97.46 (2.54%)
Sell 10 Sep @ 96.82 (3.18%)

MAR 15: Buy 10 Mar @ 97.60 (2.40%)
Result: 10 (9792-9760) 25 = + $8,000

JUN 15: Buy 10 Jun @ 97.31 (2.69%)
Result: 10 (9746-9731) 25 = + $3,750

SEP 15: Buy 10 Sep @ 97.15 (2.85%)
Result: 10 (9682-9715) 25 = – $8,250

On March 15 the treasurer takes down the loan from the bank for the next three-month period from March 15—June 15. At the same time, since the treasurer is no longer exposed to rate increases for this three-month period, the 10 March futures contract positions (which were placed to hedge against rates rising by the time the loan rate was reset on March 15) are liquidated; they are bought back at the lower price of 97.60. Thus, the gain on the hedge amounts to $8,000. The 10 contracts originally were sold at a price of 97.92 and repurchased for 97.60. With each 0.01 (i.e., a basis point) valued at $25, the ten contracts produce this $8,000 gain.

Similarly, when rate protection is no longer required as the borrowing rates are reset on June 15 and September 15, the respective sets of futures contracts are offset. On June 15 a gain of $3,750 is reaped via the futures positions, whereas on September 15 a loss of $8,250 on the futures positions is sustained. This $8,250 loss results because Eurodollar futures rates (100 minus price) moved from 3.18% on December 15 to 2.85% on September 15 of the following year. Thus, the September futures contracts were sold at a price of 96.82 and bought back at a higher price, 97.15.

Consolidation:

One cannot judge the effectiveness of a hedge by focusing solely on the cash market history. Instead, only when the cash and futures market results are consolidated can the effectiveness of the hedge be assessed. Exhibits 4 and 5 combine these results. The column entitled "Interest Expense" in Exhibit 4 provides the dollar amounts of quarterly interest payments ABC Company would have paid on the $10,000,000 loan had it not hedged in the futures market. The total amount of interest payments would have been $249,500. The right-hand column, "Hedge Results," outlines the gains/losses from the futures hedge. Combining the two columns, the net interest expense over the year sums to $246,000, for an effective all-in borrowing rate of 2.46%.

Exhibit 4 **Consolidation**

	INTEREST EXPENSE	HEDGE RESULTS
Dec 15	$47,250	~
March 15	$61,000	+ $8,000
Jun 15	$68,750	+ $3,750
Sep 15	$72,500	- $8,250
Total	$249,500	+ $3,500

Net Interest Expense = $246,000
Effective Rate = 2.46%

As displayed in Exhibit 5, the anticipated cost of funds was 2.42% and the effective borrowing rate was 2.46%. What exactly accounts for this difference between the target and actual rates?

Illustrated in Exhibit 5 are the futures liquidation rates, the actual LIBOR rates prevailing on the dates on which the loan rates were reset, and the difference between these two rates—their combined impact on the effective borrowing rate. In the first case, the March rate reset, the futures liquidation rate of 2.40% was lower than the loan rate of 2.44%. Some imprecision entered into the hedge at this point because there was not exact convergence in rates between the cash and futures markets; basis risk existed. In this instance, where the futures were bought back at a rate of 2.40% (i.e., a price of 97.60) while a cash-market LIBOR rate of 2.44% prevailed (implying a price of 97.56 when transposed for comparative purposes to the futures pricing method), the higher futures liquidation price works to the borrower's disadvantage. As a result of the hedge enlisting futures contracts, the effective cost of borrowing for the March 15—June 15 period was increased by .04/4, or four basis points for a quarter of the one-year loan period. On the other hand, addressing the September futures case, the futures liquidation date, 2.85%, was lower than the cash market LIBOR rate, 2.90%. Thus, because of the futures hedge, the effective borrowing rate for that period rises by .05/4, or 5 basis points for the September to December quarter. By summing the individual effects across the year, the four basis point difference between the anticipated cost of funds (2.42%) and the effective cost of funds (2.46%) is explained.

You should also note that basis risk can work to the advantage or disadvantage of the hedger. In this example, hedging in the futures market could have enabled the treasurer to effectively borrow at a rate which was lower than the anticipated borrowing rate depending upon where the hedger could close out the position.

Exhibit 5 **Recap and Resolution**
Anticipated Cost of Funds 2.42%
Effective Cost of Funds 2.46%

ROLLOVER	FUTURES LIQUIDATION RATE	ACTUAL BORROWING RATE (LIBOR)	EFFECT
Mar	2.40%	2.44%	+ .04/4
Jun	2.69%	2.75%	+ .06/4
Sep	2.85%	2.90%	+ .05/4

Total +.15/4
(4 basis pts.)

Hedging afforded the treasurer the opportunity to substitute basis risk, which is much smaller in magnitude, in exchange for the much larger risk associated with outright rate movements. The originally anticipated target borrowing rate of 2.42% was closely approximated by the effective funding rate, 2.46%. Thus this hedge was successful in that the target and realized rates were very close to one another; there was little deviation from the planned outcome. Still, had the corporate treasurer chosen not to hedge via the futures market, the cost of the loan would have been higher. The four basis point increased funding cost can be viewed as the cost of insurance, the premium paid for a more certain outcome. Despite the fact that the treasurer paid more for the loan than had been anticipated, the hedge performed well, especially in light of the fact that in the absence of hedging no upward limit on the loan rate would have been set. Four basis points is a small price to pay relative to the theoretically unlimited increase in the cost of the loan which would have existed had the "no-hedge" alternative been chosen.

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