FINM3405 Derivatives and Risk Management

Week 2: Futures and forwards examples and basic concepts

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Contents

Futures and forwards

Last week we gave a brief overview of derivatives and FINM3405, including looking at some relative market sizes and trading activity in order to get an idea about which are the major contracts traded globally.

- In terms of notional value daily turnover and outstanding, most trading both OTC and on exchanges is in the US, Europe and UK.
- In terms of the notional value outstanding, OTC interest rate, FX and currency swaps (and forwards) basically dwarf everything else.
- By volume, trading on exchanges is largely in equity derivatives, particularly options, and mostly index options. Most individual share options trading volume takes place on US trading venues. Most index options trading volume takes place on the NSE of India.

Futures and forwards

This week we start to dive into the details of futures and forward contracts and markets. We discuss some basic concepts, present the main classes of contracts in terms of underlying asset, and present some examples of "perfect" hedging using futures and forwards.

- Readings: Chapters 2 and 3 of Hull.

I also recommend watching the CME Group's Introduction to Futures course, which is also available on their YouTube site and gives a very useful overview of futures trading on the world's leading trading venue.

Futures and forwards

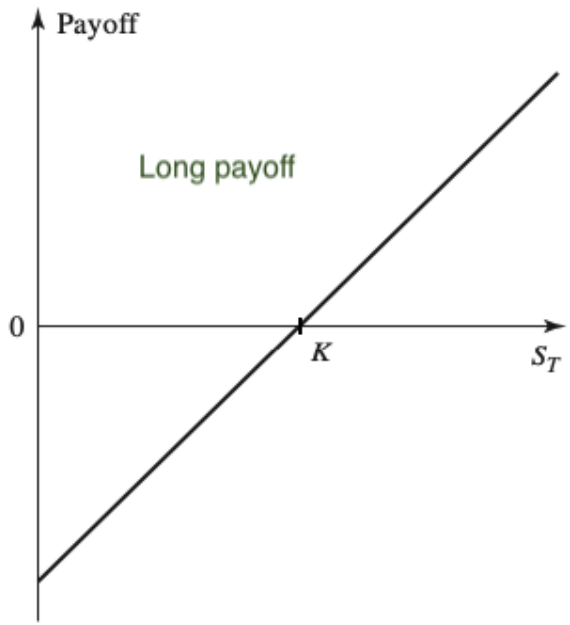
Futures and **forwards** are contracts between two parties to trade an agreed quantity m of an asset for an agreed **contract** or **forward price** K on an agreed future **delivery** or **maturity date** T.

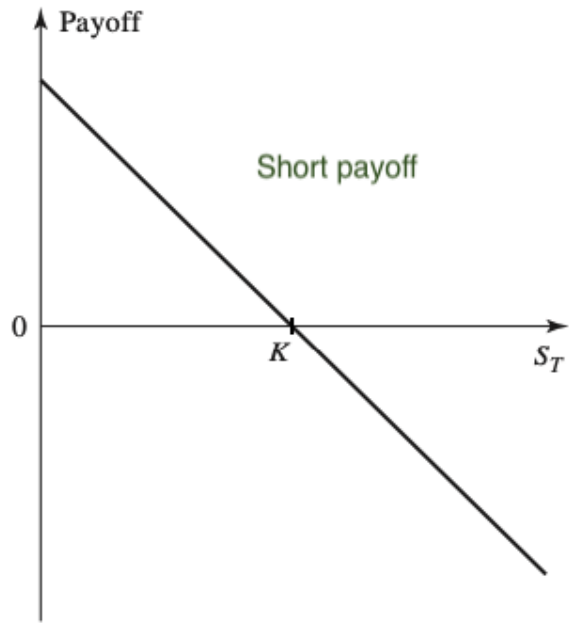
- Written over all kinds of assets including shares, ETFs, indices, commodities, interest rates, currencies, energy, weather events, etc.
- Traded all over the world, with forward contracts traded in OTC markets and futures contracts traded on organised exchanges.
- Many uses including speculation and trading, risk management or hedging, arbitrage trading and price discovery, structured and synthetic product construction, portfolio exposure modification, etc.

Futures and forwards

The **payoffs at maturity** from 1 contract (over 1 asset) are:

$$\text{long payoff} = S_T - K \qquad \text{and} \qquad \text{short payoff} = K - S_T.$$





Here S_T is the spot price of the underlying asset at maturity.

Futures and forwards

Example

I agree to buy $m = 1,000$ Alibaba ADRs (traded on NYSE under the ticker BABA) off you in 3 months for $K = \$76.50$ per ADR.

Futures and forwards

Example (Continued)

If the Alibaba's share (well, ADR) spot price in 3 months is say:

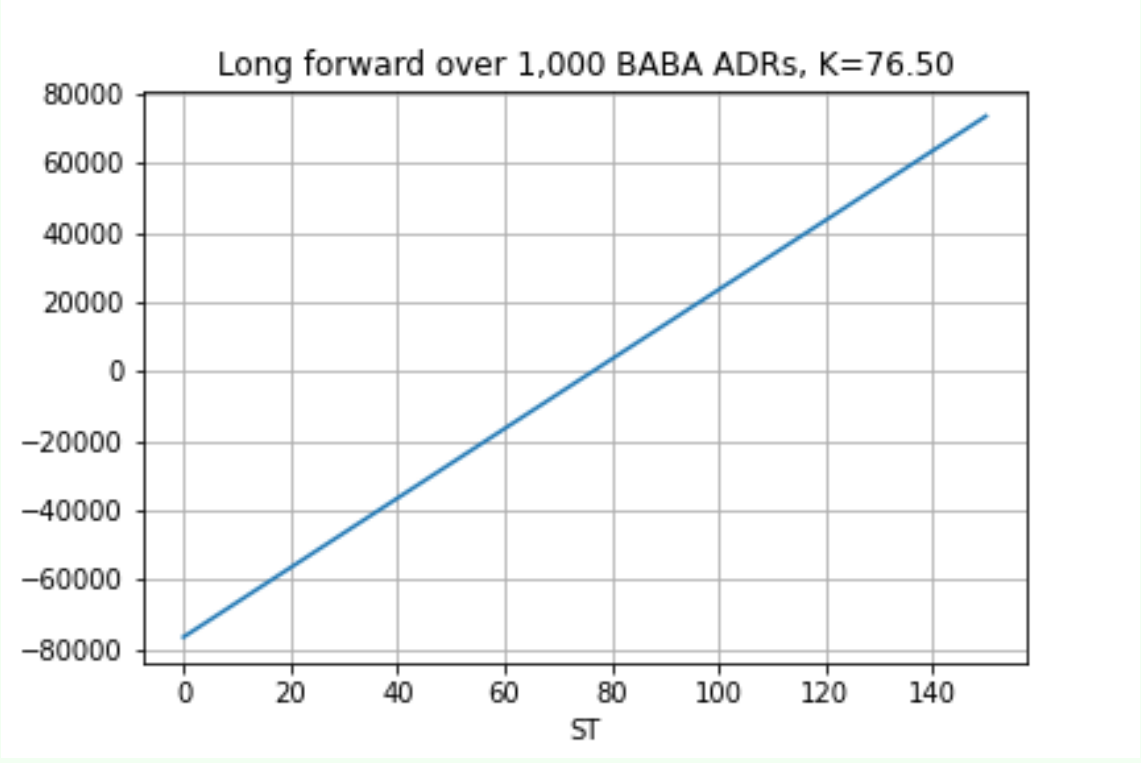
- $S_T = \$80$, then I'm happy since I'm buying BABA off you for only $K = \$76.50$ and I can sell it spot for \$80.
  - My payoff is $(S_T - K) \times m = \$3,500$ (your loss).
- $S_T = \$70$, then I'm regretting our agreement since I could have paid \$70 spot. You're happy with getting $K = \$76.50$.
  - My payoff is $(S_T - K) \times m = -\$6,500$ (your gain).

In the 2nd scenario, you hope that I fulfil my obligations and still buy it off you, and this introduces the idea of counterparty risk.

Futures and forwards

Example (Continued)

The payoff diagram for my long forward position with you is:



Futures and forwards

Example (Continued)

The above plot was produced with Python's popular NumPy and Matplotlib libraries using the following code:

```
1  import numpy as np
2  import matplotlib.pyplot as plt
3  K=76.5 # contract forward price
4  ST=np.linspace(0,150,1001) # spot price at expiry
5  long_forward=(ST-K)*1000 # long forward payoff
6  plt.figure()
7  plt.plot(ST,long_forward)
8  plt.grid()
9  plt.xlabel("ST")
10 plt.title("Long forward over 1,000 BABA ADRs, K=76.50")
```

Futures and forwards

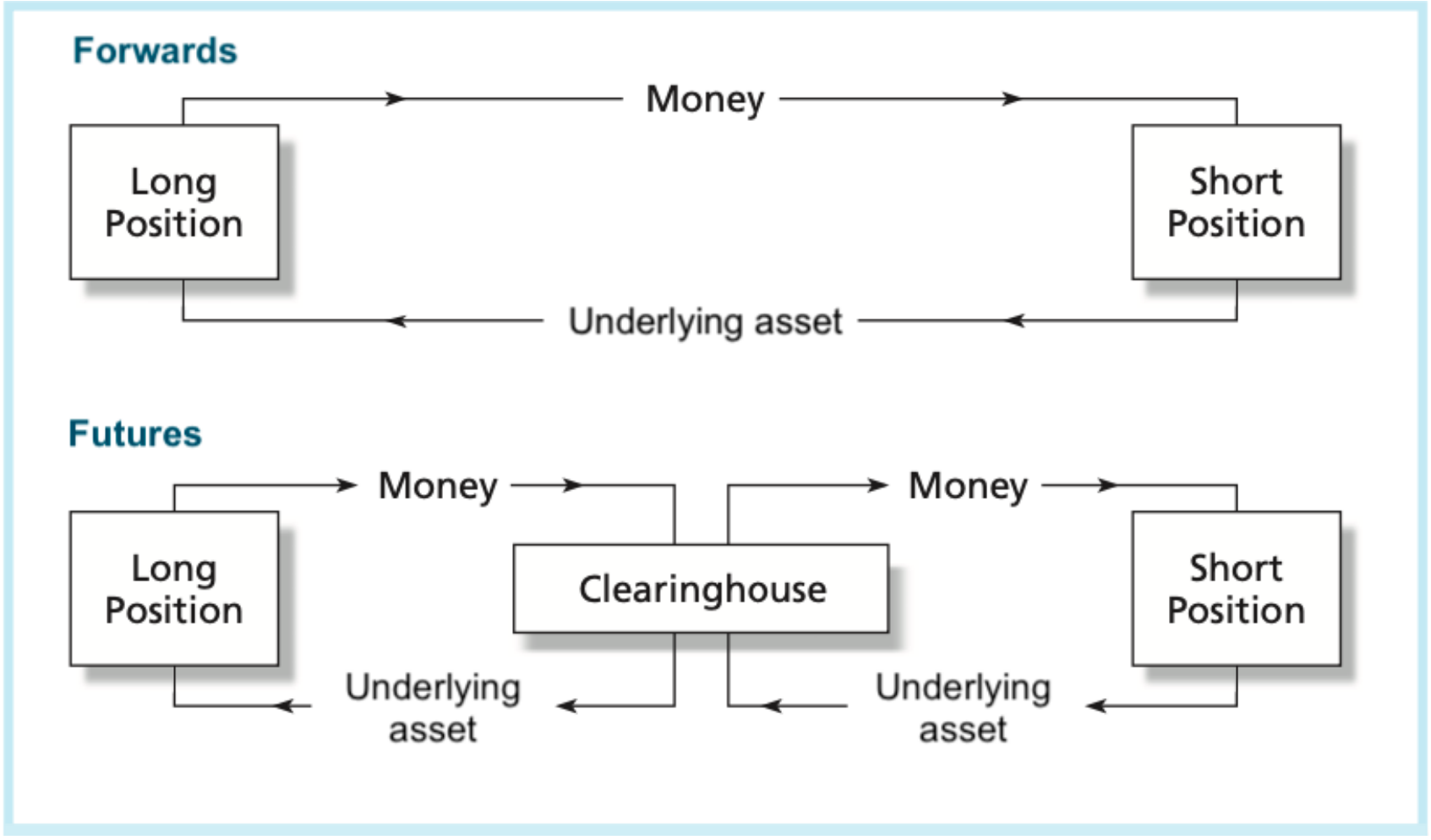
The basic difference between futures and forward contracts is:

- Futures are traded on exchanges (and other trading venues).
- Forwards are negotiated directly between market participants OTC.

This has a number of implications, including:

- Contract standardisation.
- Centralised counterparty.
- Counterparty risk.
- Trading liquidity and ability to close out positions.
- Holding to maturity vs closing out early.
- Margin mechanism and daily settlement: See below.

Futures and forwards



Futures and forwards

Features	Futures	Forwards
Trade	Futures are traded on a derivatives exchange.	Forwards are traded over the counter.
Contract's terms and conditions	The contract's terms and conditions are specified by the derivatives exchange and are thus standardised.	The contract's terms and conditions are negotiated individually between the parties, often using certain marketable features. Forwards are customised.
Market liquidity	The market liquidity is typically high.	Market liquidity varies according to market segment and product type. Only for certain derivatives such as interest rate options, interest rate swaps, and currency forwards is liquidity relatively high.
Maturity	The contract term tends to be short-term, although medium-term maturities also exist in some cases.	The maturity spectrum is very broad and ranges between short-, medium- and long-term.

Futures and forwards

Credit risk	The clearinghouse is exposed to credit risk.	For centrally cleared OTC derivatives, the clearinghouse is exposed to credit risk. In the case of bilaterally traded OTC derivatives, however, the credit risk is assumed by the owners of the long and short forward contracts, with an obligation to provide collateral.
Margins	Initial margin and variation margin	Initial margin and variation margin
Cash flow	There is a daily settlement (marking to market). The profits/losses are realised at the end of each trading day.	There is a daily settlement which results in an adjustment of the collateral so that no realised profits/ losses arise.
Contract fulfilment	Only a small percentage of the contracts are fulfilled. In most cases, the position is closed out before the end of the contract.	The fulfilment of the contract is often intentional.

Futures and forwards

These differences would seem to entail separate treatments of forwards and futures, but we can show that they can be viewed as equivalent under simplifying assumptions such as frictionless financial markets, constant or deterministic (nonrandom) interest rates, etc.

- So we treat them identically in these notes.

We use the following notation and terminology throughout these notes:

Futures trading and margins

- We work on a hypothetical time interval $[0, T]$.
  - Time $t = 0$ is a contract's **initiation date**.
  - Time T is a contract's **maturity** or **delivery date**.
  - Time t is some intermediate date: $0 \leq t \leq T$.
- S_t is the underlying asset's **spot price** at time t.
- K_t is the **contract price** at time t.
  - We write $S = S_0$ and $K = K_0$ to reduce notation.
- m is the **contract multiplier**.
- $F_t = K_t \times m$ is the **notional** or **face value** of 1 contract.
- h is the number of contracts we enter into.

Futures trading and margins

Note that it's very important to be clear about exactly what K_t is.

> K_t is the contract price when initiating a contract at time t.

- Long position at time t: Agree buy the asset for K_t at maturity T.
- Short position at time t: Agree sell the asset for K_t at maturity T.

The **futures prices** quoted on exchanges, or the **forward price** negotiated between parties OTC, is the contract price K_t.

> Remark
>
> *Pricing* a futures/forward contract at time t involves calculating the theoretically correct contract price K_t and we do it next week.

Futures trading and margins

K_t varies over time and is the price you trade futures for. Suppose you:

- Go long h contracts at time $t = 0$ for K.
- Close out your position at time $t > 0$ by shorting h contracts for K_t.
  - The contract prices K and K_t will almost certainly be different!
  - You have locked in a payout of $h(K_t - K)m$ at the delivery date T.

Futures trading involves entering into and out of futures contracts over time at different contract prices K_t up to the delivery date T.

- Traders typically trade the contract with the closest delivery date, and then roll over into the contract with the next delivery date.

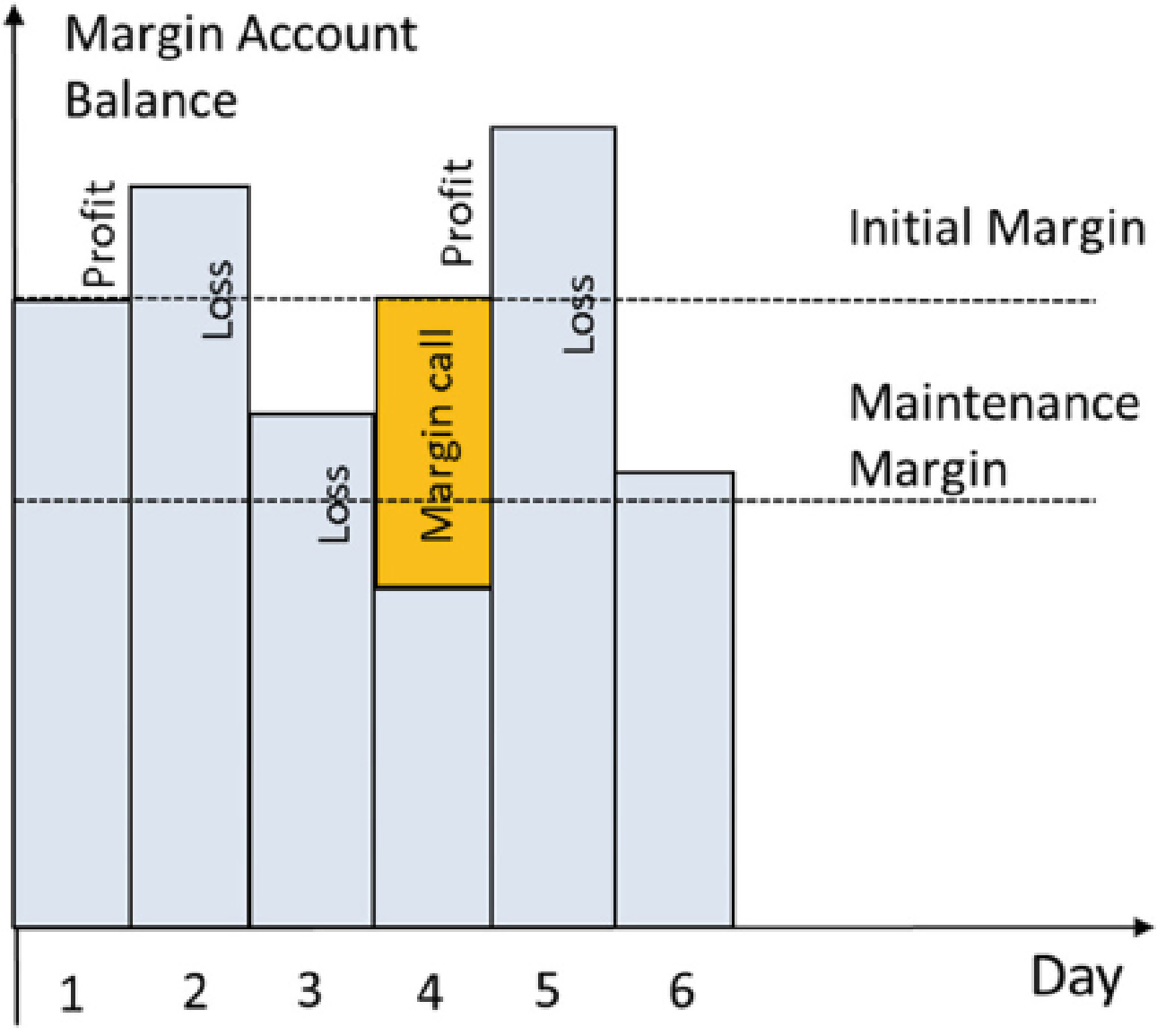
The margin mechanism governs your trading profits/losses over time:

Margin mechanism

The futures **margin mechanism** can be described as follows:

- You post an **initial margin** into your margin account, which is a percent of the contract price K (per contract).
- Your position is **marked to market** on a daily basis, with daily gains (losses) credited to (debited from) your margin account.
- There is a **maintenance margin**, usually less than the initial margin.
- If your margin account falls below the maintenance margin, you get a **margin call** to top your account back up to the initial margin.
  - If you don't pay it, the exchange closes out your position and your broker will likely "unfriend" you...
- When closing out your position before maturity, your position is immediately marked-to-market using your closing-out price.

Margin mechanism



Margin mechanism

Remark

- The above process is often called **daily settlement**.
- There may be intraday settlement and margin calls.
- You're free to use the excess funds in your margin account over and above the maintenance margin.
- Daily settlement is the main way exchanges protect themselves against counterparty risk:
  - The maintenance margin is typically less than the maximum allowable daily fluctuation or variation in the contract price.
  - If the daily variation limit is hit, a circuit breaker or trading halt occurs and all margin accounts are marked-to-market.

Margin mechanism

Example

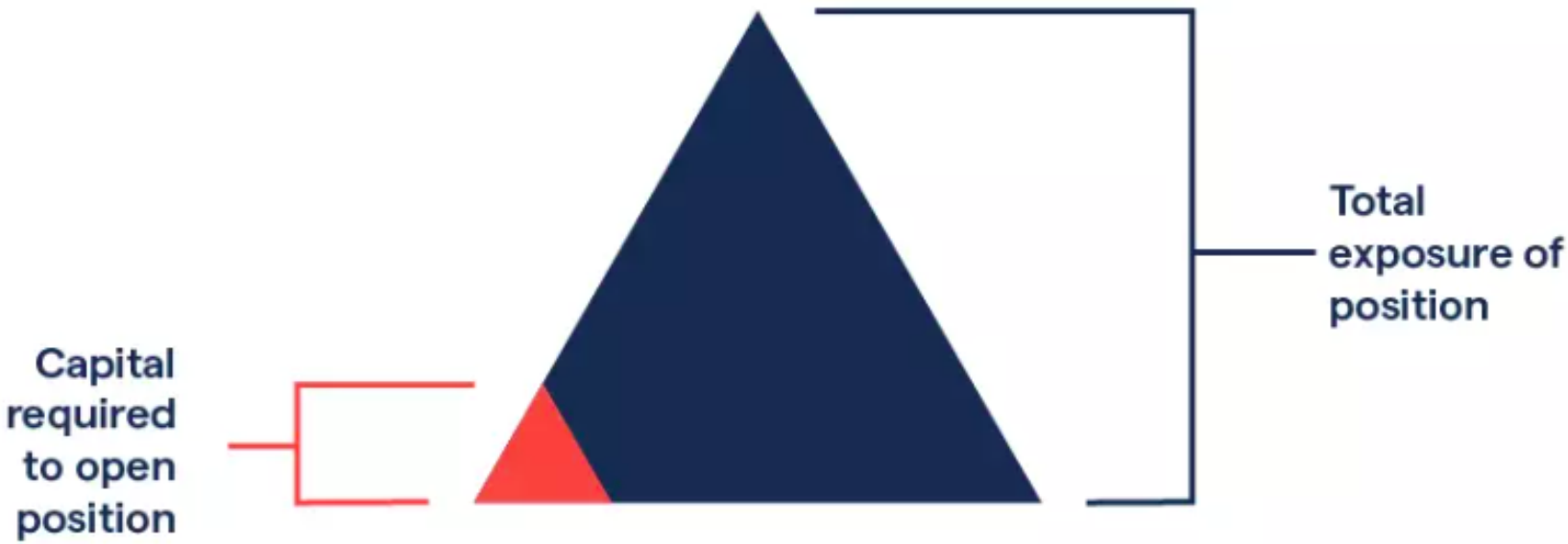
You short $h = 10$ CME gold futures at a contract price of $K = \$1,423.60$ per ounce. Each contract is over $m = 100$ ounces. The initial and maintenance margins are \$2,000 and \$1,500 per contract. You close out the short position on day 7:

Day	Futures price ($)	Daily gain/loss ($)	Cum. gain/loss ($)	Margin acc.bal. ($)	Margin call ($)
0	1423.60			20,000.00	
1	1414.80	8800.00	8800.00	28,800.00	
2	1409.40	5400.00	14,200.00	34,200.00	
3	1388.00	21,400.00	35,600.00	55,600.00	
4	1413.20	−25,200.00	10,400.00	30,400.00	
5	1426.60	−13,400.00	−3000.00	17,000.00	
6	1430.70	−4100.00	−7100.00	20,000.00	7100.00
7	1446.30 (close out)	−15,600.00	−22,700.00	4400.00	

Leverage effect

Leverage effect: Your profit/loss as a percent of the initial margin.

- The danger with futures is you post only the initial margin upfront:
  - Long position: You don't post the full amount K upfront.
  - Short position: You don't need to own the underlying asset.



Leverage effect

Example (Continued)

In the above CME gold futures example, your leverage is:

- Your cumulative loss was \$22,700.
- Your total **exposure** is

$$\text{exposure} = h \times F = h \times K \times m = \$1,423,600.$$

- Your capital outlay is the initial margin of \$20,000.

Hence, your loss as a percent of your total exposure was only 1.6%. But you lost more than 100% of your initial capital outlay!

Contract value

Another important concept is the *value* of a futures/forward position at a given point in time t that was entered into at time $t = 0$. Suppose you:

- Go long h contracts at time $t = 0$ for K.
- Close your position at time t by shorting h contracts for K_t.

The cashflow $h(K_t - K)m$ locked in at the delivery date is risk free. With r the risk-free rate, the **value** at time t of a long position is

$$V_t^{\text{long}} = e^{-r(T-t)} h(K_t - K)m.$$

The value of a short position is thus $V_t^{\text{short}} = e^{-r(T-t)} h(K - K_t)m$.

Contract value

In the above, the values at time $t = 0$ of both positions are 0.

Remark

Also note that *pricing* a forward or futures contract involves using no-arbitrage arguments to determine the *contract price* K.

- K is set so that both positions have 0 initial value.
  - Otherwise an arbitrage opportunity exists.

This concept of pricing futures/forwards so that they have 0 initial value is generalised to swaps (and many other derivatives), which are also priced so that each party's position has 0 initial value.

Examples, hedging, speculating

We now cover pricing, speculating and "perfect" hedging with futures contracts over the following general classes of underlying assets:

1. Commodities.
2. Equities:
   - Individual shares and ETFs.
   - Share indices.
3. Currencies.
4. Simple money market interest rates:
   - FRA.
   - BAB futures.

Commodity futures

Commodity futures are contracts to trade an agreed quantity m (and grade/quality) of a commodity for the contract or forward price K at the maturity or delivery date T.

Futures are written on all kinds of commodities:

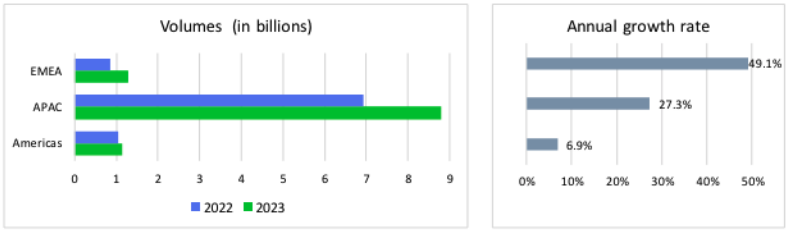
- Metals: Gold, silver, copper, aluminium, platinum, nickel, tin, etc.
- Energy and environment: Gas, oil, coal, electricity, carbon, etc.
- Agriculture and food: Beef, pork, milk, wheat, rice, corn, soy, sugar, cocoa, coffee, orange juice, wood, fertiliser, etc.

Many commodity futures are physically settled (but of course can be closed out prior to maturity). Some trading volume statistics:

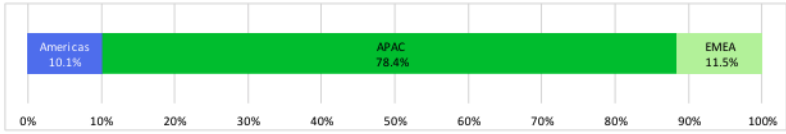
Commodity futures

Chart 42: Commodity derivatives

A. Volumes and yearly change



B. Share of volume by region



C. Share of volume by exchange

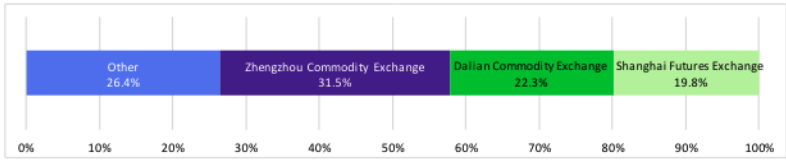


Table 8: Top 10 commodity derivatives contracts traded in 2023

Contract Name	Contract size	Exchange name	Volume 2023	Notional value 2023	Open interest 2023
Soda Ash futures	20 metric tons/lot	Zhengzhou Commodity Exchange	556,206,354	3,178,774	2,245,550
PTA futures	5 metric tons/lot	Zhengzhou Commodity Exchange	520,811,647	2,307,138	1,463,622
Methanol futures	10 metric tons/lot	Zhengzhou Commodity Exchange	399,309,189	2,114,730	1,215,575
Flat Glass futures	20 metric tons/lot	Zhengzhou Commodity Exchange	362,031,143	1,848,739	1,111,050
Soybean Meal futures	10 metric tons/lot	Dalian Commodity Exchange	354,530,779	1,893,271	2,612,235
Polyvinyl Chloride futures	5 metric tons/lot	Dalian Commodity Exchange	268,918,838	1,156,676	1,160,896
Rapeseed Meal futures	10 metric tons/lot	Zhengzhou Commodity Exchange	230,593,113	1,768,032	1,068,714
CRUDEOIL options	100 barrels	Multi Commodity Exchange of India	218,147,350	1,721,339	100,341

Table 19: Breakdown of commodity by underlying

Category	2021 volume	2020 volume	YoY change
Agriculture	2,464,404,915	2,348,625,791	5%
Energy	1,890,430,881	2,015,744,373	-6%
Index commodity derivatives	1,192,558	395,587	201%
Non-precious metals	574,875,187	593,811,889	-3%
Other commodities	1,810,205,211	1,088,975,218	66%
Precious metals	478,233,952	534,925,599	-11%
Grand Total	**7,219,342,704**	**6,582,478,457**	**9.7%**

Figure 24: Share of total volume by type of underlying: 2021 compared to 2020

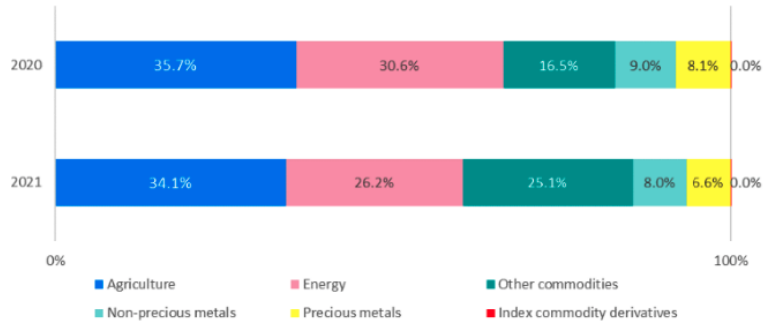


Table 17: Top 10 exchanges by number of commodity options and futures contracts traded in 2021

Exchange	Volume 2021	Volume YoY change	Notional Value 2021	Notional Value YoY change	Open interest 2021	Open interest YoY change
Zhengzhou Commodity Exchange	2,581,799,211	52%	16,946,192	84%	8,082,877	-5%
Shanghai Futures Exchange	2,445,774,713	16%	33,669,845	48%	8,261,288	26%
Dalian Commodity Exchange	2,364,418,367	7%	22,039,490	32%	11,240,066	27%
CME Group	1,032,643,593	-9%	65,859,253	21%	21,255,794	-10%
Moscow Exchange	719,098,024	-16%	521,169	39%	1,762,190	2%
ICE Futures Europe	545,487,846	1%	28,636,698	46%	11,540,047	-10%
Multi Commodity Exchange of India	177,994,581	-19%	1,108,418	-7%	328,028	69%
London Metal Exchange	145,037,570	-6%	21,094,338	34%	2,169,772	-8%
Borsa Istanbul	135,088,965	-14%	25,323	-38%	1,059,394	-43%
ICE Futures US	82,536,974	-9%	2,715,696	36%	3,056,811	1%
Others	110,736,475	16%	1,445,294	53%	4,298,435	15%
Grand Total	**10,340,616,319**	**11.5%**	**194,061,717**	**36%**	**73,054,702**	**0%**

They do lots of commodity futures trading in China! Let's take a look.

Commodity futures

The range of contracts traded on the Zhengzhou Commodity Exchange:

Commodity futures

The soda ash contract is the most heavily traded in the world by volume.

Futures Contracts | Options Contracts

Product	Soda Ash
Trading Unit	20 metric tons/lot
Price Quotation	Chinese yuan (RMB) per metric ton
Minimum Price Fluctuation	RMB 1 yuan/metric ton
Price Limit	±4% of the settlement price of the previous trading day and further subject to the price limit provisions of the Risk Control Rules of Zhengzhou Commodity Exchange
Minimum Trading Margin	5% of contract value
Delivery Months	Monthly contracts for 12 consecutive months
Trading Hours	9:00–11:30 and 13:30–15:00(Beijing time) and other trading hours prescribed by Zhengzhou Commodity Exchange
Last Trading Day	10th trading day of the delivery month
Last Delivery Day	13th trading day of the delivery month
Grade and Quality	See the Detailed Rules of Zhengzhou Commodity Exchange for Soda Ash Futures
Delivery Point	Delivery points designated by Zhengzhou Commodity Exchange
Delivery Method	Physical Delivery
Product Code	SA
Listed Exchange	Zhengzhou Commodity Exchange

Commodity futures

Futures Data | Options Data | View More

EXCEL TXT PRINT

2024-06-24 15th Trading Day of the Month 113rd Trading Day of the Year

Contract Month	Prev. Settle	Open	High	Low	Close	Settlement	Change1	Change2	Volume	Open Interest	OI Change	Turnover	Delivery Settlement Price
SA407	2,091.00	2,062.00	2,066.00	1,969.00	1,969.00	2,008.00	-122.00	-83.00	1,792	8,639	-419	7,197.89	
SA408	2,127.00	2,091.00	2,104.00	2,008.00	2,010.00	2,051.00	-117.00	-76.00	2,436	16,882	493	9,992.86	
SA409	2,137.00	2,103.00	2,117.00	2,019.00	2,023.00	2,073.00	-114.00	-64.00	1,327,401	720,154	24,797	5,504,234.06	
SA410	2,140.00	2,106.00	2,118.00	2,033.00	2,036.00	2,077.00	-104.00	-63.00	2,518	9,783	335	10,457.47	
SA411	2,104.00	2,076.00	2,086.00	2,004.00	2,007.00	2,044.00	-97.00	-60.00	1,818	11,473	401	7,432.89	
SA412	2,101.00	2,086.00	2,086.00	2,005.00	2,008.00	2,044.00	-93.00	-57.00	1,193	11,783	-88	4,877.69	
SA501	2,080.00	2,056.00	2,065.00	1,978.00	1,980.00	2,025.00	-100.00	-55.00	81,429	252,443	3,632	329,758.14	
SA502	2,092.00	2,089.00	2,089.00	1,998.00	2,001.00	2,039.00	-91.00	-53.00	250	7,633	17	1,019.62	
SA503	2,070.00	2,045.00	2,055.00	1,980.00	1,983.00	2,017.00	-87.00	-53.00	637	8,665	147	2,569.97	
SA504	2,083.00	2,055.00	2,066.00	1,998.00	2,002.00	2,030.00	-81.00	-53.00	220	4,891	13	893.10	
SA505	2,061.00	2,038.00	2,050.00	1,976.00	1,981.00	2,011.00	-80.00	-50.00	3,412	13,504	985	13,721.39	
SA506	2,067.00	2,032.00	2,032.00	1,989.00	1,998.00	2,014.00	-69.00	-53.00	55	155	2	221.53	
Sum									1,423,161	1,066,005	30,315	5,892,376.63	
Total									1,423,161	1,066,005	30,315	5,892,376.63	

Note:

(1) Price Unit: Yuan/Metric Ton.

(2) Volume, Open Interest: Lot(Single-Counted).

(3) Turnover: 10000 Yuan(Single-Counted).

(4) Change1:Close minus Prev. Settle.

(5) Change2:Settlement minus Prev. Settle.

Commodity futures "perfect hedging"

To use futures to hedge an exposure to the underlying asset:

- Go long to hedge against prices going up.
- Go short to hedge against prices going down.

Example

You want to buy 20 metric tons of soda ash in September in China, and don't want to risk soda ash prices going up.

- To lock in a purchase contract price of $K = 2,023$ CNY/ton ($\approx$ \$420/ton) you go long $h = 1$ September futures contract.
- On the 10^{th} trading day of September, you buy 20 tons of soda ash for $h \times K \times m = 40,460$ CNY (about \$8,371).

Commodity futures "perfect hedging"

Remark

We call this "perfect hedging" since:

- The underlying asset in the contract is exactly the asset exposure we want to hedge.
- The number of units in the underlying asset we want to hedge is covered by an integer number of contracts.
- And our hedge date is exactly the contract delivery date.

But things are rarely this "neat" in reality so next week we cover the notion of optimal hedging.

Commodity futures speculating

To use futures to speculate on the direction of the underlying asset:

- Go long if you expect prices to go up.
- Go short if you expect prices to go down.

Suppose you go long h contracts at time $t = 0$ at K, and then closed it out at time $t > 0$ by shorting h contracts at K_t. Your payoff at time t is

$$\text{long position payoff} = h(K_t - K)m.$$

If you initially went short then your payoff is

$$\text{short position payoff} = h(K - K_t)m.$$

Commodity futures speculating

Example

In the above CME gold futures example you were short $h = 10$ contracts, each over $m = 100$ ounces. Your initial short sale contract price was $K = 1,423.6$ per ounce and your closing out contract price was $K_t = 1,446.3$. We calculate your payoff as

$$\text{short position payoff} = h(K - K_t)m = -\$22,700.$$

If you went long you would have made a profit since gold went up.

Equity futures

- **Share and ETF futures** are contracts to trade a quantity m of shares in a company or ETF for the contract price K at maturity T.
- **Share index futures** are contracts to trade a "share market index" for the contract price K (in units of the index) at maturity T.
  - The **notional** or **face value** of a share index futures contract is calculated as $F = K \times m$, where m is the **multiplier**.

Individual share and ETF futures are typically physically settled but share index futures are usually cash settled (not possible to "trade a whole share index", but ETF futures effectively enable this). Market statistics:

Equity futures

Chart 22: Single stock futures

Chart 26: Stock index futures

Table 2: Top 10 single stock futures contracts traded in 2023

Contract Name	Contract size	Exchange name	Volume 2023	Notional value 2023	Open interest 2023
DRV Futures SamsungElec	10 shares	Korea Exchange	264,208,938	137,910	1,351,962
EKGYO	100 shares	Borsa Istanbul	219,173,227	5,949	1,017,050
YKBNK	100 shares	Borsa Istanbul	208,914,608	10,070	1,262,703
ISCTR	100 shares	Borsa Istanbul	167,042,797	9,557	762,644
AKBNK	100 shares	Borsa Istanbul	132,405,823	10,874	554,567
ODAS	100 shares	Borsa Istanbul	115,117,731	4,121	593,957
DRV Futures SK hynix	10 shares	Korea Exchange	57,184,852	48,533	241,469
DRV Futures Doosan Enerbility	10 shares	Korea Exchange	35,994,862	4,689	107,617
DRV Futures Kakao	10 shares	Korea Exchange	28,440,923	11,584	737,571
DRV Futures POSCO DX	10 shares	Korea Exchange	25,319,846	7,037	200,119

Table 4: Top 10 exchanges by number of single stock futures contracts traded in 2021

Exchange	Volume 2021	Volume YoY change	Notional Value 2021	Notional Value YoY change	Open interest 2021	Open interest YoY change
Borsa Istanbul	1,748,803,926	46%	117,664	13%	11,769,481	43%
Korea Exchange	1,224,916,827	9%	932,929	27%	6,331,508	-8%
B3 - Brasil Bolsa Balcão	939,130,833	162%	3,568	111%	30,823,900	39%
Moscow Exchange	284,110,558	44%	94,858	77%	3,179,752	174%
National Stock Exchange of India	252,568,663	-2%	2,852,311	26%	2,644,078	69%
Eurex	102,877,662	22%	428,719	14%	10,549,222	32%
Taiwan Futures Exchange	74,994,818	190%	582,949	140%	528,576	42%
Thailand Futures Exchange	70,326,055	48%	NA	NA	3,221,487	81%
Johannesburg Stock Exchange	25,031,971	46%	23,719	120%	2,273,733	25%
Bourse de Montreal	22,359,988	91%	112,344	120%	479,000	61%
Others	72,753,782	0%	1,539,796	17%	3,526,882	14%
Grand Total	**4,817,875,083**	**41.9%**	**6,688,857**	**30%**	**75,327,619**	**36%**

Table 4: Top 10 stock index futures contracts traded in 2023

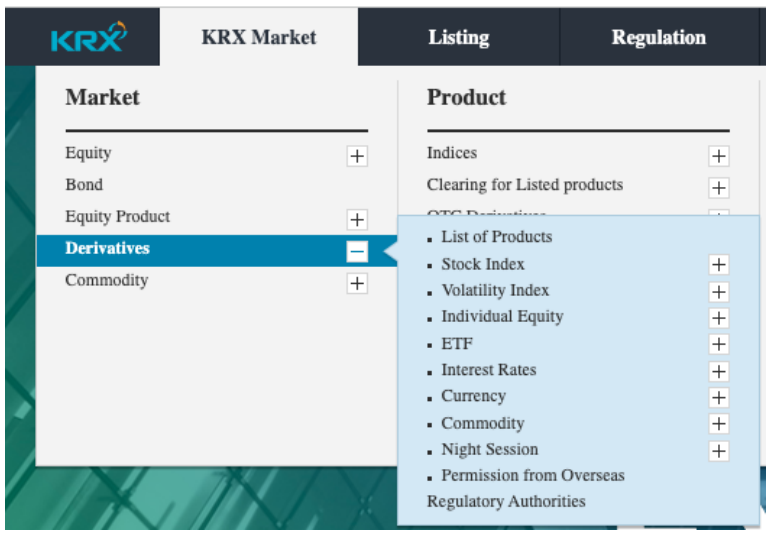
Contract Name	Contract size	Exchange name	Volume 2023	Notional value 2023	Open interest 2023
E-MINI S&P 500 FUTURES	US$ 50 x S&P 500 Index	CME Group	452,701,954	97,084,415	2,210,568
MICRO E-MINI NASDAQ 100 FUTURE	US$ 2 x Nasdaq-100 Index	CME Group	273,085,353	7,782,474	84,325
MICRO E-MINI S&P 500 FUTURES	$5 x S&P 500 Index	CME Group	248,272,150	5,289,226	126,922
FUT ON EURO STOXX 50	EUR 10 x index pts	Deutsche Boerse AG	245,759,267	11,577,162	2,557,226
E-MINI NASDAQ 100 FUTURES	US$ 20 x Nasdaq-100 Index	CME Group	166,975,397	47,613,994	284,624
FTSE China A50 Index futures	US$ 1 x futures price	Singapore Exchange	88,569,512	NA	933,790
FUT ON EURO STOXX BANKS	EUR 50 x index pts	Deutsche Boerse AG	71,140,765	420,746	872,925
DRV Futures KOSPI 200	KRW 250,000	Korea Exchange	63,693,515	4,053,549	343,922
SET50 Index Futures	THB 200 x index pts	Thailand Futures Exchange	62,142,760	670,437	549,607
BIST30	10 x BIST30 index	Borsa Istanbul	60,638,950	143,291	245,474

Table 8: Top 10 exchanges by number of stock index futures contracts traded in 2021

Exchange	Volume 2021	Volume YoY change	Notional Value 2021	Notional Value YoY change	Open interest 2021	Open interest YoY change
B3 - Brasil Bolsa Balcão	4,635,926,846	58%	21,259,755	64%	1,161,892	26%
CME Group	1,199,850,886	-4%	156,902,744	19%	4,216,814	1%
Eurex	427,873,692	-29%	22,792,243	-20%	10,210,973	-4%
Japan Exchange Group	281,426,655	-29%	14,339,735	-16%	1,248,898	-14%
Moscow Exchange	170,198,291	-1%	521,374	29%	643,300	39%
Singapore Exchange	169,113,478	-9%	NA	NA	1,468,648	7%
Taiwan Futures Exchange	118,411,890	6%	7,531,968	42%	162,218	-9%
Korea Exchange	118,261,251	-23%	6,758,521	-1%	564,970	-14%
Hong Kong Exchanges and Clearing	100,555,940	-10%	10,646,408	6%	675,762	19%
Borsa Istanbul	95,121,918	-7%	119,217	-33%	353,312	-29%
Others	468,187,996	-15%	30,999,129	-1%	9,859,819	63%
Grand Total	**7,784,928,843**	**18.7%**	**271,871,095**	**11%**	**30,566,606**	**13%**

Equity futures

Lots of individual share futures trading on the Korean Exchange (KRX):



Single Stock Futures

Underlying asset	**Underlying Asset List(SSF) (Click)**
Month of settlement	Two non-quarterly months, four quarterly months (March, June, September, December).
Last trading day	2nd Thursday of the contract month
First trading day	The 1st business day after the last trading day
Trading hours	09:00 ~ 15:45 (09:00 ~ 15:20 on the last trading day)
Contract size	10 shares
Price indication	Price of equity futures (KRW)
Final settlement date	Following day of the final trading day
Tick size	The price of single stock futures: Tick size Less than KRW 2,000: KRW 1 KRW 2,000 ~ Less than KRW 5,000: KRW 5 KRW 5,000 ~ Less than KRW 20,000: KRW 10 KRW 20,000 ~ Less than KRW 50,000: KRW 50 KRW 50,000 ~ Less than KRW 200,000: KRW 100 KRW 200,000 ~ Less than KRW 500,000: KRW 500 KRW 500,000 or more: KRW 1000
Daily price limit	① 10% ② 20% ③ 30% price limits are applied to the futures base price
Maximum order quantity	The quantity separately set by the KRX among 1,000 contracts, 2,000 contracts, 5,000 contracts and 10,000 contracts (for more details, refer to changes in the quotation quantity limits).
Margin requirement	Set according to respective riskiness of underlying equities
Periodic call auction	When the market opens (08:30 - 09:00) and trading ends except on the final trading day (15:35 - 15:45).
Trading suspension if necessary (Circuit Breakers)	Trading of equity futures is suspended temporarily when the stock price changes dramatically.

Equity futures

Regarding share index futures, the CME Group "*is the world's leading derivatives marketplace, made up of four exchanges, CME, CBOT, NYMEX and COMEX*." Their Micro E-mini futures are very popular share index futures contracts:

Equity futures

CONTRACT SPECIFICATIONS

	MICRO E-MINI S&P 500	MICRO E-MINI NASDAQ-100	MICRO E-MINI RUSSELL 2000	MICRO E-MINI DOW	MICRO E-MINI S&P MIDCAP 400	MICRO E-MINI S&P SMALLCAP 600
CONTRACT SIZE	$5 x S&P 500 Index	$2 x Nasdaq-100 Index	$5 x Russell 2000 Index	$0.50 x DJIA Index	$10 x S&P MidCap 400 Index	$10 x S&P SmallCap 600 Index
TRADING AND CLEARING HOURS	CME Globex and ClearPort: 5:00 p.m. to 4:00 p.m., Sunday-Friday					
MINIMUM PRICE FLUCTUATION*	Outright: 0.25 Index points, equal to $1.25 per contract. Calendar spread: 0.05 Index points, equal to $0.25 per calendar spread.	Outright: 0.25 Index points, equal to $0.50 per contract. Calendar spread: 0.05 Index points, equal to $0.10 per calendar spread.	Outright: 0.10 Index points, equal to $0.50 per contract. Calendar spread: 0.05 Index points, equal to $0.25 per calendar spread.	Outright: 1.00 Index points, equal to $0.50 per contract. Calendar spread: 1.00 Index points, equal to $0.50 per calendar spread.	Outright: 0.10 Index points, equal to $1.00 per contract. Calendar spread: 0.05 Index points, equal to $0.50 per calendar spread.	Outright: 0.10 Index points, equal to $1.00 per contract. Calendar spread: 0.05 Index points, equal to $0.50 per calendar spread.
PRODUCT CODE	CME Globex: MES CME ClearPort: MES Clearing: MES	CME Globex: MNQ CME ClearPort: MNQ Clearing: MNQ	CME Globex: M2K CME ClearPort: M2K Clearing: M2K	CME Globex: MYM CME ClearPort: MYM Clearing: MYM	CME Globex: MMC CME ClearPort: MMC Clearing: MMC	CME Globex: MSC CME ClearPort: MSC Clearing: MSC
CONTRACT MONTHS	Five months in the March Quarterly Cycle (March, June, September, December)			Four months in the March Quarterly Cycle (March, June, September, December)	Five months in the March Quarterly Cycle (March, June, September, December)	
DELIVERY	Delivery is by cash settlement by reference to Final Settlement Price, equal to Special Opening Quotation of Index based on opening prices of Index component stocks.					
TERMINATION OF TRADING	Last Day of Trading is 3rd Friday of contract delivery month. Trading in expiring futures terminates at 8:30 a.m. CT on Last Day of Trading.					
BLOCK TRADE ELIGIBILITY	No					
EXCHANGE RULE	These contracts are listed with and subject to the rules and regulations of CME.			These contracts are listed with and subject to the rules and regulations of CBOT	These contracts are listed with and subject to the rules and regulations of CME.	

**Prices are quoted and traded in Index points.*

Equity futures

The most heavily traded is the E-mini S&P500 futures contract:

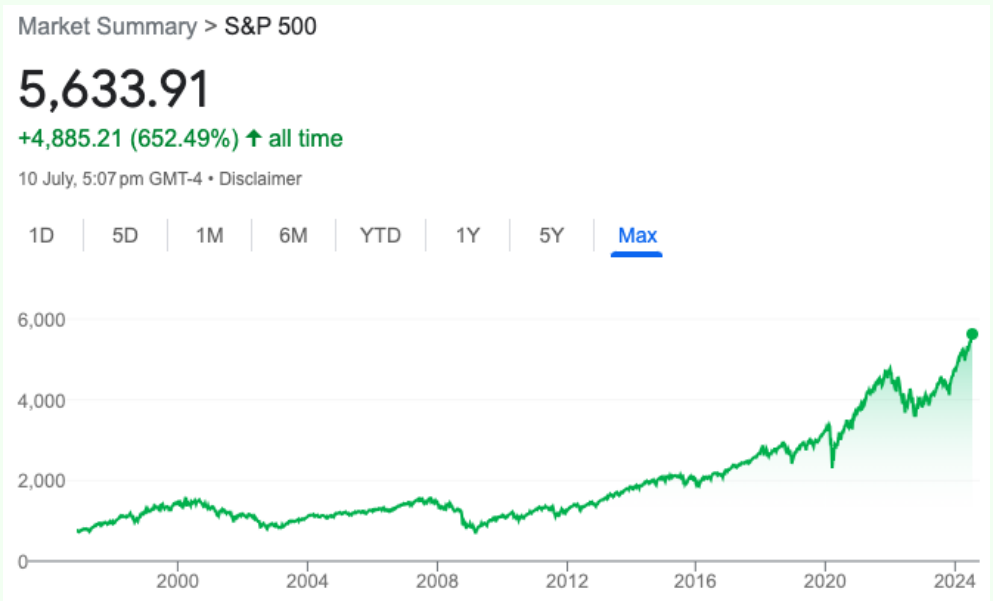
E-MINI S&P 500 FUTURES - CONTRACT SPECS

CONTRACT UNIT	$50 x S&P 500 Index
PRICE QUOTATION	U.S. dollars and cents per index point
PRODUCT CODE	**CME Globex:** ES **CME ClearPort:** ES **Clearing:** ES **BTIC:** EST **TACO:** ESQ **TMAC:** ESX
LISTED CONTRACTS	Quarterly contracts (Mar, Jun, Sep, Dec) listed for 21 consecutive quarters BTIC & TACO: Eligible in all listed contract months TMAC: Eligible in the contract month nearest to expiry. The next quarterly TMAC is eligible for trading on Sunday of the week of the prior contract month's expiration.
SETTLEMENT METHOD	Financially Settled
TERMINATION OF TRADING	Trading terminates at 9:30 a.m. ET on the 3rd Friday of the contract month. TACO trading terminates at 9:30 a.m. ET on the Thursday before the 3rd Friday of the contract month. BTIC trading terminates at 4:00 p.m. ET on the Thursday before the 3rd Friday of contract month. TMAC trading terminates at 4:00 p.m. ET on the Thursday before the 3rd Friday of the contract month.
TAM OR TAS RULES	Trade Marker at Close (TMAC) is subject to the requirements of Rule 524.D. TMAC trades off a "Base Price" of zero to create a differential versus the daily Marker at Close price on the underlying futures contract month. The TMAC clearing price equals the daily Market at Close price of the underlying futures contract month plus or minus the TMAC transaction price.
SETTLEMENT PROCEDURES	Settlement Procedures ↗
POSITION LIMITS	Position Limits ↗

Equity futures "perfect hedging"

Example

You manage an ETF that tracks the S&P 500 Index but also allows you to use futures contracts to hedge against market falls. You're worried that the index is in bubble territory.



Equity futures "perfect hedging"

Example (Continued)

You hold equivalently 5,000 units in the index, at a value of \$28,169,550. You short $h = 100$ December E-mini S&P500 contracts for a total exposure of $h \times K \times m = \$28,740,000$.

E-MINI S&P 500 FUTURES - QUOTES VENUE: GLOBEX

AUTO-REFRESH IS OFF *Last Updated 10 Jul 2024 10:31:09 PM CT. Market data is delayed by at least 10 minutes.*

MONTH	OPTIONS	CHART	LAST	CHANGE	PRIOR SETTLE	OPEN	HIGH	LOW	VOLUME	UPDATED
SEP 2024 ESU4	OPT		5682.50	-5.50 (-0.10%)	-	5684.25	5686.00	5679.00	22,842	22:21:52 CT 10 Jul 2024
DEC 2024 ESZ4	OPT		5748.00	-3.75 (-0.07%)	-	5748.00	5749.00	5744.75	37	21:33:09 CT 10 Jul 2024

Suppose the index falls 20% by December to $S_T = 4,507$.

Equity futures "perfect hedging"

Example (Continued)

In December, your ETF's value fell to \$22,535,000. Your futures cash payout is $h(K - S_T)m = \$6,205,000$. Hence, your final position is $\$28,740,000$. This is more than your original ETF value of \$28,169,550, and is due to the basis:

- Initially, $S = 5,633.91$ and $K = 5,748$.
  - The initial **basis** is $B = K - S = 114.09$.
- At maturity $K_T = S_T = 4,507$.
  - The final basis is $B_T = K_T - S_T = 0$.
- We talk more about basis next week.

Equity futures speculating

This example also illustrates speculating with index futures.

Example

The above example shows what happens if you shorted $h = 100$ December E-mini S&P500 contracts and the S&P 500 did fall, in line with your expectations. Your profit is \$6,205,000. But:

- If you were long, hoping for the index to keep going up like it has been, you would have lost this amount. Leverage:
  - The initial margin is $\approx 5\%$ so $\approx \$1,437,000$.
  - The loss wrt a long position's total exposure is $\approx 22\%$, with the extra 2% over the index fall due to the basis.
  - Wiped out your initial margin 3 times over if you were long.

FX futures

Foreign exchange (FX) futures are contracts to exchange an agreed quantity of m units in one currency A for another currency B for the contract price (forward exchange rate) $K_{A:B}$ at maturity T.

Our quoting convention for exchange rates is 1 unit of currency A exchanges for $K_{A:B}$ units of currency B. We then have that 1 unit of currency B exchanges for $K_{B:A} = 1/K_{A:B}$ units of currency A.

The following market statistics show that there's quite a lot of FX futures (and options) trading volume on the NSE of India:

FX futures

Chart 30: Currency derivatives

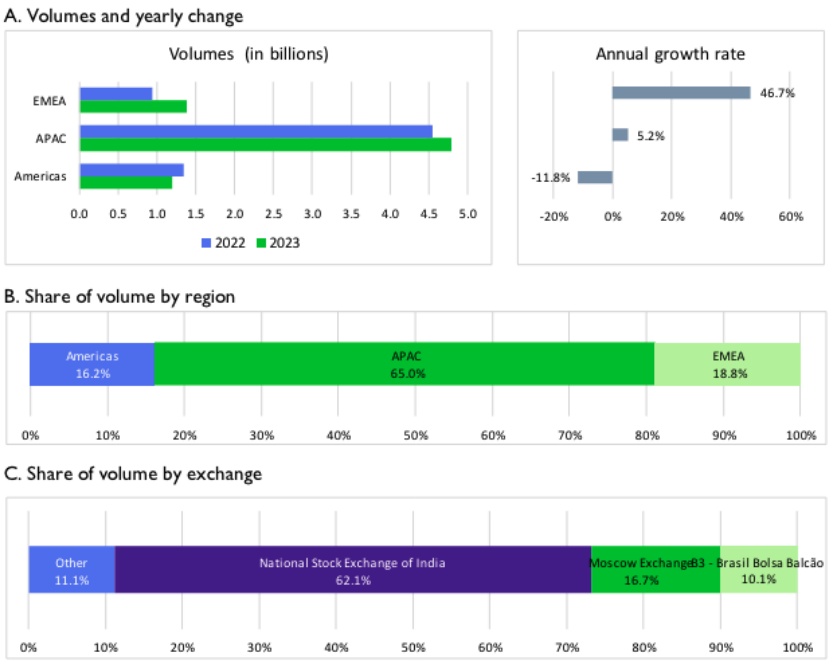


Table 5: Top 10 currency derivatives contracts traded in 2023

Contract Name	Contract size	Exchange name	Volume 2023	Notional value 2023	Open interest 2023
USD/INR options	US$ 1,000	National Stock Exchange of India	3,620,372,162	3,596,697	11,574,294
USD/INR futures	US$ 1,000	National Stock Exchange of India	788,813,312	783,472	6,019,974
DLR futures	US$ 1,000	Matba Rofex	189,413,867	80,426	919,663
DRV futures USD	US$ 10,000	Korea Exchange	108,034,964	1,087,524	891,938
GBP/INR futures	GBP 1,000	National Stock Exchange of India	77,131,286	95,417	333,974
EURO FX futures	EUR 125,000	CME Group	58,393,916	7,901,544	716,725
USD/TRY futures	US$ 1,000	Borsa Istanbul	56,359,634	46,661	1,847,364
EUR/INR futures	EUR 1,000	National Stock Exchange of India	55,931,315	60,198	454,663
USD/INR options	US$ 1,000	Metropolitan Stock Exchange of India	55,139,166	27,393	115,998
JAPANESE YEN futures	JPY 12,500,000	CME Group	44,265,092	3,965,732	186,824

Table 15: Top 10 exchanges by number of currency options and futures contracts traded in 2021

Exchange	Volume 2021	Volume YoY change	Notional Value 2021	Notional Value YoY change	Open interest 2021	Open interest YoY change
National Stock Exchange of India	2,267,659,129	50%	2,303,140	47%	9,843,109	29%
Moscow Exchange	906,732,901	4%	920,686	5%	5,005,194	23%
B3 - Brasil Bolsa Balcão	771,574,015	-1%	10,333,376	-6%	2,837,511	-63%
CME Group	201,255,084	-8%	19,339,802	-6%	2,661,130	17%
Matba Rofex	110,771,755	-2%	109,902	4%	4,316,024	11%
Korea Exchange	100,221,006	-7%	965,747	-25%	837,885	-7%
Borsa Istanbul	96,995,469	52%	73,056	15%	2,398,488	-22%
Johannesburg Stock Exchange	51,993,895	-17%	50,029	-31%	6,219,424	-5%
Singapore Exchange	26,569,612	4%	NA	NA	152,628	14%
Bolsa y Mercados Argentinos	11,720,720	-22%	11	-100%	14,120	-15%
Others	51,362,968	1%	5,759,241	259%	2,879,117	71%
Grand Total	**4,596,856,554**	**20.3%**	**39,854,989**	**7%**	**37,164,630**	**-2%**

Figure 20: Volumes of currency derivatives

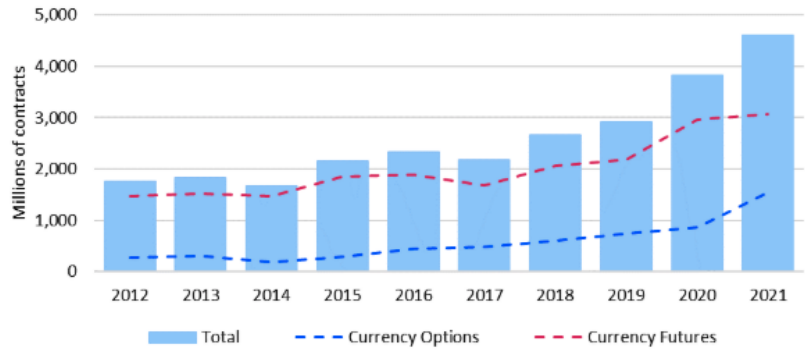
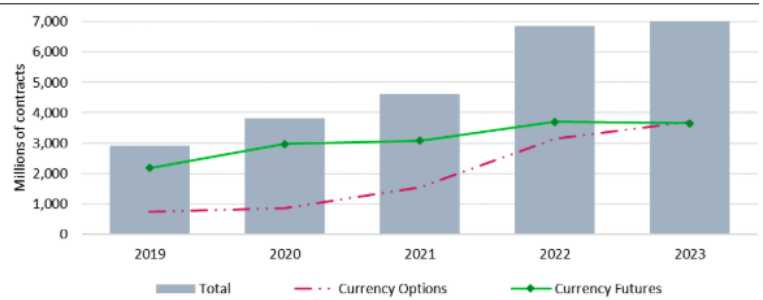


Chart 27: Currency derivatives



FX futures

Contract Specifications - Futures & Options on INR pairs

Futures Contracts Specifications | Options Contracts Specifications

SYMBOL	USDINR	EURINR	GBPINR	JPYINR
MARKET TYPE	N	N	N	N
INSTRUMENT TYPE	FUTCUR	FUTCUR	FUTCUR	FUTCUR
UNIT OF TRADING	1 - 1 unit denotes 1000 USD.	1 - 1 unit denotes 1000 EURO.	1 - 1 unit denotes 1000 POUND STERLING.	1 - 1 unit denotes 100000 JAPANESE YEN.
UNDERLYING / ORDER QUOTATION	The exchange rate in Indian Rupees for US Dollars. Exchange rate published by FBIL	The exchange rate in Indian Rupees for Euro. Exchange rate published by FBIL	The exchange rate in Indian Rupees for Pound Sterling. Exchange rate published by FBIL	The exchange rate in Indian Rupees for 100 Japanese Yen. Exchange rate published by FBIL
TICK SIZE	0.25 paise or INR 0.0025			
TRADING HOURS	Monday to Friday **9:00 a.m. to 5:00 p.m.**			
CONTRACT TRADING CYCLE	11 serial weekly cycle (excluding expiry week wherein monthly contracts expires on a Friday) and 12 month trading cycle.			
LAST TRADING DAY	All weekly expiration contracts will expire on Friday of the expiring week All contracts other than weekly, will expire Two working days prior to the last business day of the expiry month at 12:30 pm and trade modification end time will be till 01:00 PM. If expiry month date falls on holiday, then the expiry date will be revised for the existing available expiry contract and same will be intimated in a separate circular			

FX futures

POSITION LIMITS	Position Limits for CDS Segment			
INITIAL MARGIN	SPAN Based Margin			
EXTREME LOSS MARGIN	1% of MTM value of gross open position	0.3% of MTM value of gross open position	0.5% of MTM value of gross open position	0.7% of MTM value of gross open position
CALENDAR SPREADS MARGIN	Rs.400 for spread of 1 month Rs.500 for spread of 2 months Rs.800 for spread of 3 months Rs.1000 for spread of 4 months and more	Rs.700 for spread of 1 month Rs.1000 for spread of 2 months Rs.1500 for spread of 3 months and more	Rs.1500 for spread of 1 month Rs.1800 for spread of 2 months Rs.2000 for spread of 3 months and more	Rs.600 for spread of 1 month Rs.1000 for spread of 2 months Rs.1500 for spread of 3 months and more
SETTLEMENT	**Daily settlement** : T + 1 **Final settlement** : T + 2			
MODE OF SETTLEMENT	Cash settled in Indian Rupees			
DAILY SETTLEMENT PRICE (DSP)	Calculated on the basis of the last half an hour weighted average price across exchanges.			
FINAL SETTLEMENT PRICE (FSP)	RBI reference rate	RBI reference rate	Exchange rate published by RBI in its Press Release captioned RBI reference Rate for US$ and Euro	Exchange rate published by RBI in its Press Release captioned RBI reference Rate for US$ and Euro

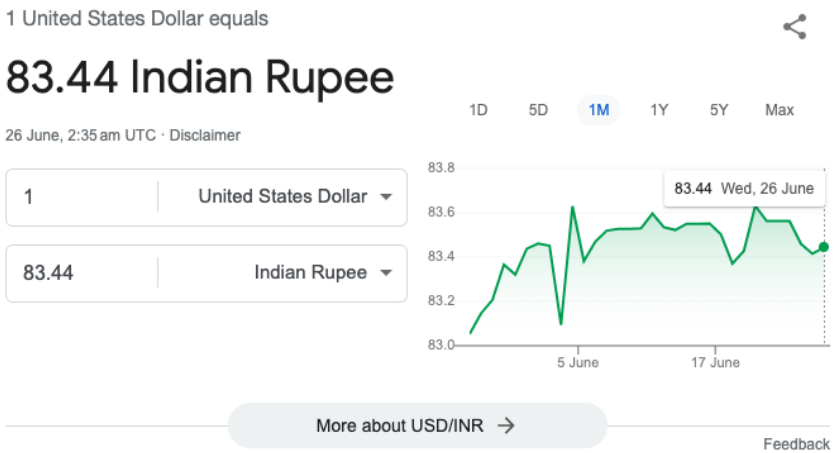
FX futures

INSTRUMENT TYPE	SYMBOL	EXPIRY DATE	TYPE	STRIKE PRICE	SPREAD	LTP	CHNG	%CHNG	VOLUME (Contracts)	VALUE (₹ Crores)	OPEN INTEREST (Contracts)	NO. OF TRADES
Currency Futures	USDINR	26-Jun-2024	-	-	0.0025	**83.4300**	-0.06	-0.07	6,07,466	5,068.62	20,81,712	7,546
Currency Futures	USDINR	29-Jul-2024	-	-	0.0050	**83.5100**	-0.05	-0.07	5,49,891	4,592.39	23,15,875	7,410
Currency Futures	USDINR	28-Aug-2024	-	-	0.0250	**83.6000**	-0.01	-0.01	6,095	50.94	33,201	222
Currency Futures	EURINR	26-Jun-2024	-	-	0.0900	**89.4500**	-0.06	-0.07	3,225	28.88	9,789	154
Currency Futures	EURINR	29-Jul-2024	-	-	0.0075	**89.6700**	-0.04	-0.04	2,514	22.56	5,173	152
Currency Futures	GBPINR	29-Jul-2024	-	-	0.0050	**105.9225**	0.19	0.18	2,197	23.27	4,701	192
Currency Futures	GBPINR	26-Jun-2024	-	-	0.0500	**105.8500**	0.13	0.12	1,687	17.87	5,277	146
Currency Futures	JPYINR	26-Jun-2024	-	-	0.0400	**52.3900**	0.05	0.10	1,436	7.51	4,229	62
Currency Futures	JPYINR	29-Jul-2024	-	-	0.0150	**52.7000**	0.02	0.03	587	3.09	1,814	41
Currency Futures	GBPINR	28-Aug-2024	-	-	0.0400	**105.8200**	0.02	0.02	547	5.79	600	51
Currency Futures	USDINR	26-Sep-2024	-	-	0.0850	**83.7925**	0.03	0.04	367	3.07	53,871	18
Currency Futures	USDINR	27-Dec-2024	-	-	0.2000	**83.9800**	-0.12	-0.14	357	3.00	17,765	18
Currency Futures	USDINR	29-Oct-2024	-	-	0.1400	**83.7500**	-0.07	-0.08	199	1.67	23,793	16
Currency Futures	EURINR	28-Aug-2024	-	-	0.1400	**90.0500**	0.05	0.06	49	0.44	274	6

FX futures

These NSE of India futures quoting convention is that 1 unit of foreign currency exchanges for $K_{\text{foreign:INR}}$ Indian Rupee.

- A common sense check might be to look at the last traded price (LTP) of say the top contract expiring 26-June-2024, which is $K_{\text{USD:INR}} = 83.43$, and then check the current spot rate:



Ok, I'm confident that we've got things around the right way...!

FX futures

Remark

One way to think about these FX futures quoting conventions is that the foreign currency is being viewed as the "underlying asset". Thus the futures price $K_{\text{USD:INR}}$ is telling us how much Indian Rupee it "costs" to buy 1 unit of the underlying asset.

FX futures "perfect hedging"

Example

You're an exporter from India who sells in the USA, receiving USD payment. You'll be receiving \$1,000,000 in September and want to lock in the USD:INR exchange rate to get Indian Rupee.

- Short $h = 1,000$ 26-Sep-2024 USDINR futures for a forward exchange rate of $K_{\text{USD:INR}} = 83.7925$.
- One contract is for $m = \$1,000$ so on 26-Sep-2024 you get

$$F = K_{\text{USD:INR}} \times m = 83,792.5\,\text{INR}$$

per contract, so $h \times F = 83,792,500\,\text{INR}$ in total.

FX futures speculating

This example also illustrates speculating with FX futures.

Example

In the above example you took a short futures position, which is what you'd do if you believed the USD will depreciate against the Rupee. Suppose that it did and to $S_{T,\text{USD:INR}} = 80$. Your profit is

$$h(K_{\text{USD:INR}} - S_{T,\text{USD:INR}})m = 3,792,500\,\text{INR}.$$

If you were long then this would be a loss.

Interest rate contracts

We now present two simple interest rate contracts:

- Forward rate agreements (FRA), which are OTC interest rate forward contracts over some global reference rate.
- 90 Day Bank Accepted Bill (BAB) Futures, which are an Australian ASX traded futures equivalent of a FRA over the BBSW rate.

FRA

A **forward rate agreement** (**FRA**) is a OTC traded forward contract over a reference interest rate such as SOFR or EURIBOR.

> In an FRA the parties agree to fix an interest rate k over an agreed notional value F for an agreed time period T starting on the FRA's agreed maturity date T_1 and ending on $T_2 = T_1 + T$.

FRA fix a simple interest rate k to begin at maturity T_1 for borrowing or lending over the time period $[T_1, T_2]$ of length T, but are cash settled, so no actual borrowing or lending takes place at time T_1.

- A FRA's payoff at maturity T_1 depends on the difference $k - r$, where r is the spot reference rate at time T_1 for the period $[T_1, T_2]$.

FRA

Pricing an FRA involves calculating the agreed upon rate k, which we call the **fixed rate**, and we cover this next week. Using this terminology:

- Being long an FRA involves locking in k as a lending or investment rate, and this party is called the **fixed rate receiver**.
  - Think of this as agreeing to lend or invest F at maturity, time T_1, and thus to receive the investment proceeds $F(1 + kT)$ at time T_2.
- Being short an FRA involves locking in k as a borrowing or funding rate, and this party is called the **fixed rate payer**.
  - Think of this as agreeing to borrow F at maturity, time T_1, and thus to pay off the loan amount of $F(1 + kT)$ at time T_2.

FRA

FRA are cash settled, so we want to calculate its payoff, that is, its net cashflow to each party, at maturity T_1. We do it as follows:

- At the FRA's fixed rate k, the amount invested at time T_1 to get the agreed cashflow $C = F(1 + kT)$ at time T_2 is

$$P_k = \frac{C}{1 + kT} = F.$$

- But at the spot reference rate r at time T_1, the amount invested is

$$P_r = \frac{C}{1 + rT}.$$

- If $k > r$ the FRA benefits the fixed rate receiver, by $P_r - P_k > 0$.
- If $k < r$ the fixed rate receiver is disadvantaged, by $P_r - P_k < 0$.

FRA

We can easily calculate that

$$P_r - P_k = \frac{F(k-r)T}{1+rT}.$$

The cashflow and thus **payoff** to the fixed rate receiver at maturity is

$$\text{fixed rate receiver payoff} = P_r - P_k = \frac{F(k-r)T}{1+rT}.$$

The payoff to the fixed rate payer at maturity is the negative of this.

FRA

Example

You enter into a 3×9 FRA over SOFR as the fixed rate receiver on a notional or face value of $F = \$1,000,000$: You agree to fix a 9 month lending rate k starting in 3 months over $\$1,000,000$.

DATE	CME TERM SOFR (%)			
	1 MONTH	3 MONTH	6 MONTH	12 MONTH
25 Jul 2024	5.34712	5.26356	5.1075	4.76862

Next week we show that the correct fixed rate k to use is the embedded forward rate from the above Term SOFR yield curve.

FRA

Example (Continued)

Hence, the fixed rate k satisfies

$$1 + r_{12} = \left(1 + r_3 \frac{90}{360}\right)\left(1 + k \frac{270}{360}\right),$$

where r_3 and r_{12} are the 3 and 12 month SOFR rates. We get

$$k = \left(\frac{1 + r_{12}}{1 + r_3 \frac{90}{360}} - 1\right)\frac{360}{270} = 0.0454385.$$

Note that $T_1 = \frac{90}{360}$, $T = \frac{270}{360}$ and $T_2 = 1$.

FRA

Example (Continued)

Suppose that at maturity T_1, in 3 months time, the spot 9 month Term SOFR rate is $r = 4.25\%$. As the fixed rate receiver, you agreed to receive $k = 4.54385\%$ in the FRA. So your payoff is

$$\text{fixed rate receiver payoff} = \frac{F(k-r)T}{1+rT} = \$2,135.78.$$

The fixed rate payer transfers this amount to you at maturity.

We continue with this example to illustrate hedging with an FRA. Note that the yield curve was forecasting the spot 9 month Term SOFR rate to be $k = 4.54385\%$ in 3 months, but it ended up being lower at $r = 4.25\%$.

OTC FRA "perfect hedging"

Example

Suppose you did intend to invest $F = \$1,000,000$ in 3 months, time T_1, for a 9 month period at the Term SOFR rate. The theoretical cashflow at time T_2 you agree to receive in the FRA is $F(1 + kT) = \$1,034,078.86$. At time T_1 you invest \$2,135.78 from the FRA plus F at the spot SOFR rate $r = 4.25\%$ to get

$$(F + 2135.78)(1 + rT) = \$1,034,078.86.$$

Hence, you fixed your investment rate at the yield curve's (money market's) forecasted rate of $k = 4.54385\%$ via the FRA.

OTC FRA speculating

The above example also illustrates speculating with a FRA.

Example

From above, the money market was forecasting the spot 9 month Term SOFR rate to be $k = 4.54385\%$ in 3 months time, but it ended up lower at $r = 4.25\%$. In this case, the fixed rate receiver had a positive payoff from the FRA.

To speculate with FRA, if you expect interest rates to be:

- Lower than the yield curve is forecasting:
  - Enter into a FRA as the fixed rate receiver.
- Higher than the yield curve is forecasting:
  - Enter into a FRA as the fixed rate payer.

BAB futures

The ASX's 90 Day Bank Accepted Bill (BAB) Futures contract is effectively a standardised, ASX traded "FRA" but over the Bank Bill Swap (BBSW) rate, which is the main reference rate in Australia. Also:

- You can only lock in the BBSW rate for 90 day periods.
- The BBSW rate's day count convention divides by 365, the standard day count convention in Australian money markets, so $T = \frac{90}{365}$.
- The face value of 1 contract is $F = \$1,000,000$ but this refers to the hypothetical cashflow at time $T_2 = T_1 + T$, so we use slightly different equations to calculate the values P_r and P_k and hence the net cashflow or payoffs at maturity T_1 as we did for FRA:

BAB futures

To calculate the payoffs at contract maturity T_1, let:

- k be the fixed rate agreed to in the BAB futures.
- r be the spot 90 day BBSW rate at maturity T_1.

At k, the amount invested at maturity T_1 to receive $F = \$1,000,000$ at time T_2 is $P_k = \dfrac{F}{1 + k\frac{90}{365}}$. At r, this amount is $P_r = \dfrac{F}{1 + r\frac{90}{365}}$.

- The **payoff** $P_r - P_k$ at maturity T_1 to the fixed rate receiver is:

$$\text{fixed rate receiver payoff} = F\left(\frac{1}{1 + r\frac{90}{365}} - \frac{1}{1 + k\frac{90}{365}}\right).$$

- The payoff to the fixed rate payer is the negative of this.

BAB futures

Australian 90 day bank accepted bill futures

Commodity code	• IR
Contract unit	• A$1,000,000 face value 90 day bank accepted bills of exchange or EBAs
Contract months	• March/June/September/December up to 20 quarter months or five years ahead
Minimum price movement	• Quoted in yield per cent per annum in multiples of 0.01%. • One hundred minus annual percentage yield quoted to two decimal places. • Minimum fluctuation of 0.01% = approx. AU$24 per contract (varying with level of interest rates)
Contract expiry	• 8:29am on the business day immediately prior to settlement day • Expiry Settlement Price is determined at 10:30am on the final trading day
Settlement	**Settlement method** • Cash settled. The expiry settlement price shall be calculated as 100 minus the 3 month BBSW rate published on the Last Trading Day. The BBSW rate will be rounded to 3 decimal places to the nearest 0.001%, 0.0005% rounded up. **Settlement day** • Settlement day is the second Friday of the delivery month
Trading hours	• 5:08pm – 7:00am and 8:28am – 4:30pm[2] (For period from second Sunday in March to first Sunday in November) • 5:08pm – 7:30am and 8:28am – 4:30pm[2] (For period from first Sunday in November to second Sunday in March)
Regulatory approvals	Approved for trading by: • US Commodity Futures Trading Commission (CFTC) • UK Financial Conduct Authority (FCA) • Monetary Authority of Singapore (MAS) • Hong Kong Securities and Futures Commission (SFC Hong Kong).
Expiry Position Limits	20,000 contracts (applies to spot month net open positions at the close of trading on the day before expiry T-1)

Note that BAB futures are quoted as $100 - k\%$, so the last traded September contract below has fixed rate $k = 100 - 95.53 = 4.47\%$:

BAB futures

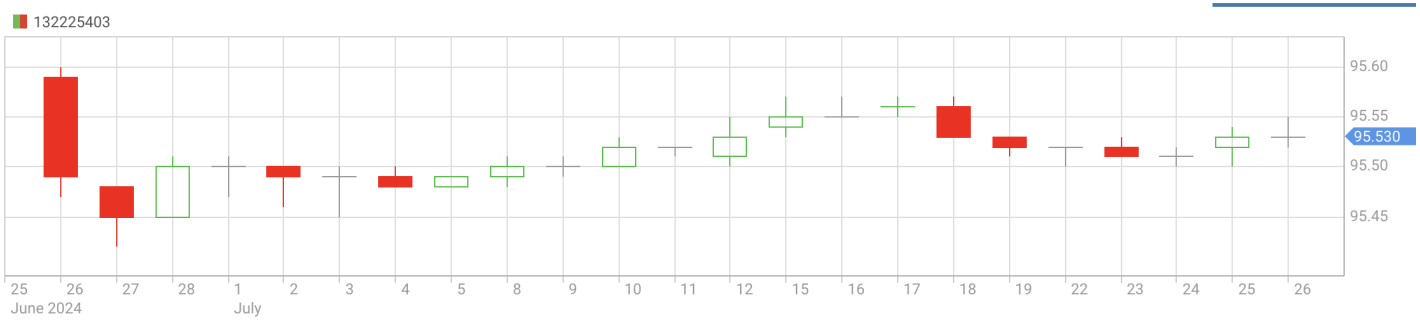
Short Term Derivatives

30 DAY INTERBANK CASH RATE | 90 DAY BANK BILL | NEW ZEALAND 90 DAY BANK BILL

90 day bank bill IR

FUTURES | OPTIONS

1 MONTH



EXPIRY DATE	BID	OFFER	LAST TRADE	CHANGE	VOLUME	PREVIOUS SETTLEMENT
Sep 24	95.5200	95.5300	95.5300 As of 26/07/24	--	22415	95.5300 As of 25/07/24
Dec 24	95.5800	95.5900	95.5900 As of 26/07/24	--	23734	95.5900 As of 25/07/24
Mar 25	95.7100	95.7200	95.7200 As of 26/07/24	--	23466	95.7200 As of 25/07/24
Jun 25	95.8400	95.8500	95.8400 As of 26/07/24	▽ 0.0100	15388	95.8500 As of 25/07/24
Sep 25	95.9600	95.9700	95.9600 As of 26/07/24	▽ 0.0200	14387	95.9800 As of 25/07/24
Dec 25	96.0600	96.0700	96.0600 As of 26/07/24	▽ 0.0200	21335	96.0800 As of 25/07/24

BAB futures

How would you calculate trading profits/losses in BAB futures?

Example

Say you go long $h = 1$ September BAB futures at $k = 4.47\%$.

Think of this as agreeing to buy (invest in) 1 BAB at maturity for

$$P_k = \frac{F}{1 + k\frac{90}{365}} = \$989,098.24.$$

Suppose that at a later date t the fixed rate increases to $k_t = 5\%$,

and you short 1 BAB futures to close out your long position.

BAB futures

Example (Continued)

Think of this as agreeing to sell (issue) 1 BAB at maturity for

$$P_{k_t} = \frac{F}{1 + k_t \frac{90}{365}} = \$987,821.38.$$

The payoff from your long trade is

$$P_{k_t} - P_k = -\$1,276.86.$$

You lost money since the fixed rate rate went up: The money market increased its forecast for 90 day BAB yields in September.

The daily margin mechanism is calculated in a similar way.

Summary

- Futures and forwards
- Futures trading and margins
  - Margin mechanism
  - Leverage effect
  - Contract value
- Commodity futures
- Equity futures
- FX futures
- Interest rate contracts
  - FRA
  - BAB futures