

Introduction to Financial Derivatives

A derivative can be defined as a financial instrument whose value depends on (or derives from) the values of other, more basic, underlying variables. Very often the variables underlying derivatives are the prices of traded assets. A stock option, for example, is a derivative whose value is dependent on the price of a stock.

Buying a derivative is like placing a side bet on the future price of something — you don't own it, but your gain or loss depends entirely on where the price goes. For e.g., if a farmer buys a weather futures, he hedges the risk of adverse weather in the future.

1. Futures

A futures contract is a legal agreement between a buyer and a seller in which:

- The buyer agrees to take delivery of something at a specified price at the end of a designated period of time.
- The seller agrees to make delivery of something at a specified price at the end of a designated period of time.

The price at which the parties agree to transact in the future is called the futures price. The designated date at which the parties must transact is called the settlement date or delivery date. The “something” that the parties agree to exchange is called the underlying.

Example: Suppose a futures contract is traded on an exchange where the underlying to be bought or sold is an asset (gold), and the settlement is three months from now. Assume further that trader A buys this futures contract, and trader B sells this futures contract, and the price at which they agree to transact in the future is \$100. Then \$100 is the futures price.

Long futures vs. short futures: When an investor takes a position in the market by buying a futures contract (or agreeing to buy at a future date), the investor is said to be in a long position or to be long futures. If, instead, the investor's opening position is the sale of a futures contract (which means the contractual obligation to sell something in the future), the investor is said to be in a short position or short futures.

1.1 Role of Clearing-House:

In the world of futures trading, a clearinghouse plays a crucial role in ensuring the smooth and efficient operation of the market. It acts as an intermediary between buyers and sellers, providing a centralized platform for the clearing and settlement of futures contracts.

A clearinghouse is an organization that acts as a counterparty to every trade executed on a futures exchange. It acts as a guarantor, assuming the risk of default by either party involved in a trade.

When someone enters into a futures contract, they're required to deposit a minimum amount per contract, known as the initial margin. This acts as collateral and is mandated by the exchange. The margin can be held in the form of interest-earning assets like Treasury bills.

[What Is Futures Trading?](#)

<https://youtu.be/9BQr-vxwqJs?si=jSmnEh4uk3gCnwI1>

2. Forwards

A forward contract, just like a futures contract, is an agreement for the future delivery of the underlying at a specified price at the end of a designated period of time.

- Futures contracts are standardized agreements as to the delivery date (or month) and quality of the deliverable and are traded on organized exchanges.
- A forward contract differs in that it is usually non-standardized (that is, the terms of each contract is negotiated individually between buyer and seller), there is no clearinghouse, and secondary markets are often nonexistent or extremely thin.
- Unlike a futures contract, which is an exchange traded product, a forward contract is an over-the-counter instrument.
- Because there is no clearinghouse that guarantees the performance of a counterparty in a forward contract, the parties to a forward contract are exposed to counterparty risk, the risk that the other party to the transaction will fail to perform.
- Futures contracts are marked to market at the end of each trading day, while forward contracts usually are not.
- Consequently, futures contracts are subject to interim cash flows because additional margin may be required in the case of adverse price movements or because cash may be withdrawn in the case of favorable price movements.
- A forward contract may or may not be marked to market.
- Where the counterparties are two high-credit-quality entities, the two parties may agree not to mark positions to market.
- However, if one or both of the parties are concerned with the counterparty risk of the other, then positions may be marked to market.
- Thus, when a forward contract is marked to market, there are interim cash flows just as with a futures contract.
- When a forward contract is not marked to market, then there are no interim cash flows.

[Forward Contract: How to Use It, Risks, and Example](#)

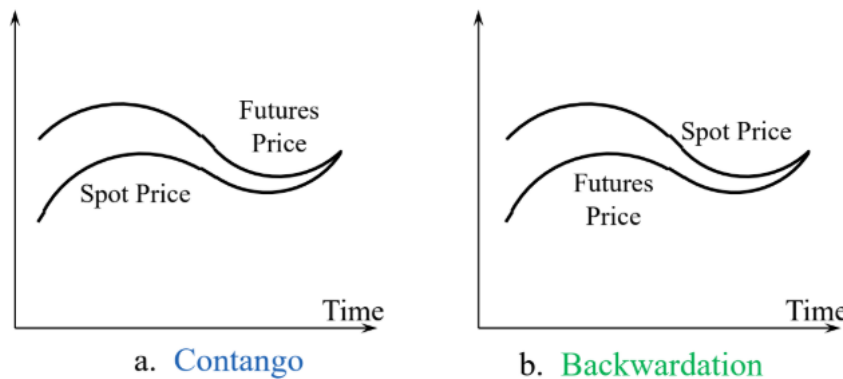
<https://youtu.be/423QLJo2-Jo?si=64Gh3RCgnSut1P4d>

3. Valuations of Futures and Forwards

Futures prices can be:

- An increasing function of maturity: $F > S$; Contango; Normal.
- A decreasing function of maturity: $F < S$; Backwardation; Inverted.

Futures Price converges to Spot Price at maturity, if the spot asset is the same asset underlying the futures contract.



The forward price of any contract is determined by the cost of carry. This cost reflects what an investor would spend to buy and hold the asset until the contract's maturity, minus any returns they'd earn while holding it.

Carrying costs can include things like interest on borrowed funds, storage fees, and insurance. On the flip side, carrying returns are benefits the investor gets from owning the asset — like dividends or bonuses paid out during that period.

So, the net cost of carry is basically the total carrying costs minus the carrying returns.

Some Notations:

Notation and background:

- T = Time until delivery of the forward contract (fraction of year)
- S = Spot price of underlying asset at time t (today)
- S_t : Spot price of underlying asset at time T (maturity), a random variable
- K : Delivery price promised in forward contract at time T
- F : Forward price prevailing in market at time t
- f : Value of a long forward contract at time t
- r : Risk free rate per annum at time t , for investment maturing at T

The forward price of an asset is calculated as the spot price plus the net cost of carrying the asset from now until the contract's maturity.

There are three main scenarios depending on the kind of return the underlying asset provides:

- If the asset doesn't generate any income, the forward price is: $F_{(0,T)} = S_0 e^{RT}$
- If the asset provides a known cash income (like a dividend payout), the formula becomes: $F_{(0,T)} = (S_0 - I) e^{RT}$, where I is the present value of that income.
- If the asset offers a known continuous yield (like a percentage return over time), the forward price is given by: $F_{(0,T)} = S_0 e^{(R-q)T}$, where q is the continuous yield.

These formulas give us the theoretical fair value of the forward contract.

Key terms:

- $F_{(0,T)}$: Forward price set today for a contract that matures at time T
- T : Time to maturity in years (e.g., $T = 0.5$ means a 6-month forward)
- S_0 : Spot price of the asset today
- R : Risk-free rate (continuously compounded)
- I : Present value of any known income the asset generates
- q : Known continuous yield provided by the asset

[Forward Price: Definition, Formulas for Calculation, and Example](#)