Introduction to Derivatives

Course Objectives

Understand what a derivative contract is

Explain a forward contract

Explain a futures contract

Understand option contracts

Outline the components of a swap contracts

Derivative Contracts

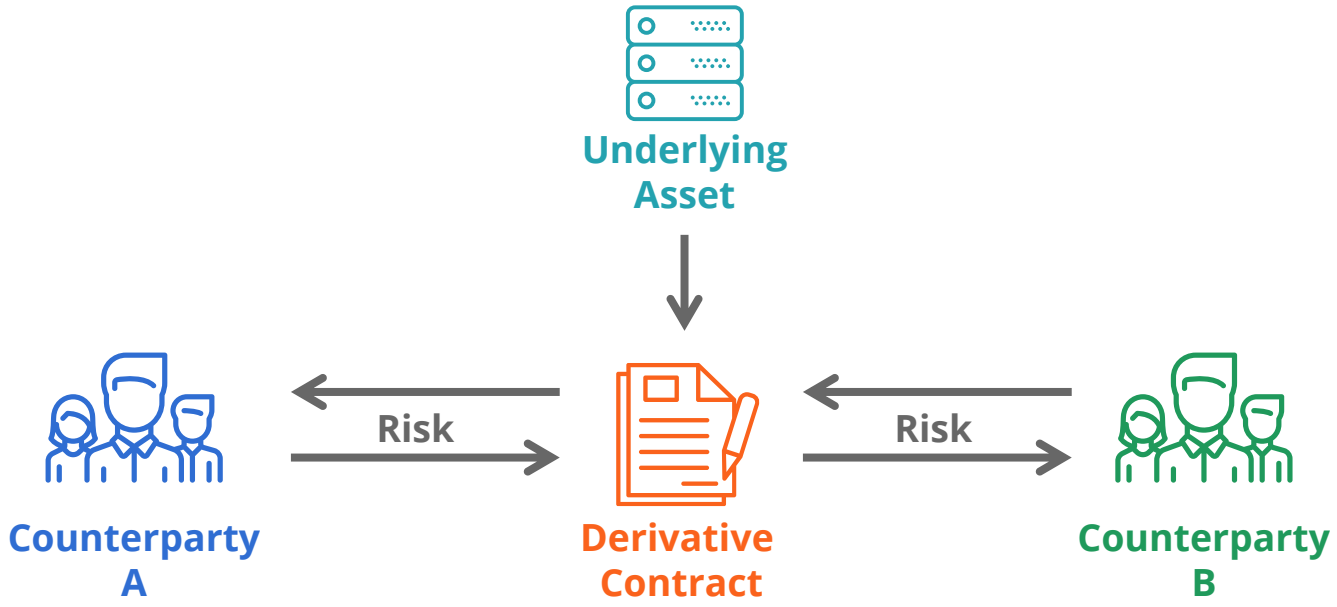
What is a Derivative Market?

Markets are used to transfer goods, services, funds, or risks.

Derivative market is a market developed over time to transfer risk from one party to another.

What is a Derivative Contract?

A derivative contract derives its value from an underlying asset such as a stock, currency, or commodity, hence the name derivative.



Components of a Derivative Contract

Derivative contracts will generally include these important components:

An Underlying Asset

Counterparties with Long / Short Positions

An Expiration or Maturity Date

Derivative Contract Underlying Assets

A derivative contract will derive its value based on the dynamic value of an underlying asset. A few common underlying assets are:

Stocks

Bonds

Currencies

Commodities

Market Indices

Interest Rates

Long Position and Short Position

In a derivative contract, one party is often described as holding a long position while the other holds a short position.

Long Position

Counterparty A

Benefits when the value of the underlying asset increases

Short Position

Counterparty B

Benefits when the value of the underlying asset decreases

Derivative Contract Expiration/Maturity Date

Derivative contracts will also include an expiration or maturity date. This is the date when the contract agreement ends and any differences in the two positions are finally settled.

Derivatives will also specify delivery type at expiration when applicable:

Physical Delivery

Physical delivery means that at the expiration date, the quantity of the underlying asset specified in the contract will be delivered to buyer.

VS

Cash-Settled

Cash-settled means that differences in the counterparties' positions will be settled in cash rather than delivering the underlying asset.

Over-the-Counter vs. Exchange-Traded

Derivative contracts can be traded either over the counter, or through exchanges.

Over-the-Counter

Customized contracts made through a broker-dealer, or directly between the two counterparties.

VS

Exchange-Traded

Standardized contracts that are freely traded on a formal, organized exchange.

Uses of Derivatives Contracts

Derivatives are generally used for two purposes: hedging and speculating.

Hedging

Hedging involves protecting a current financial position from potential losses.

VS

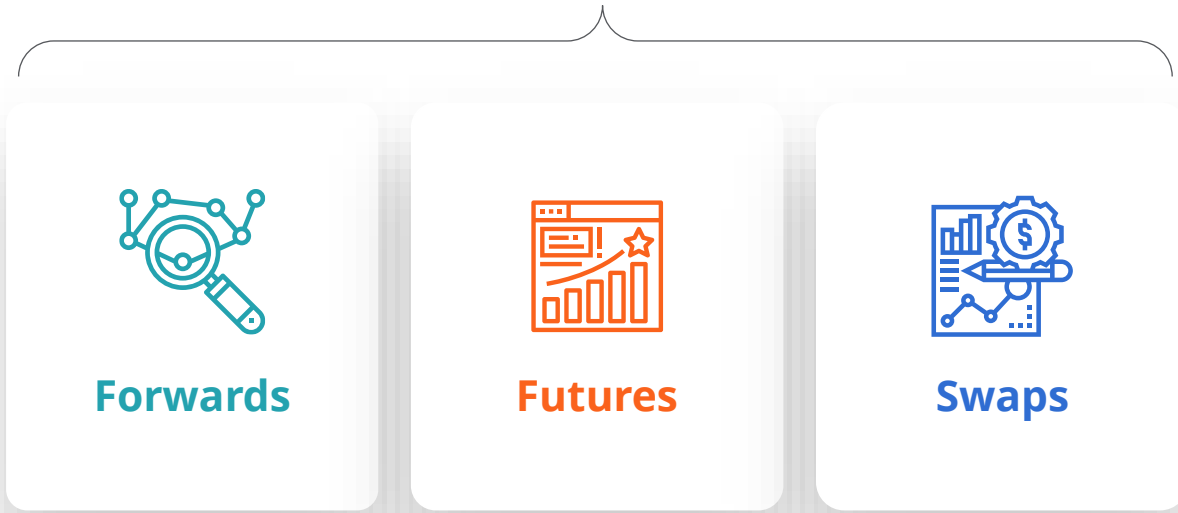
Speculating

Speculating involves trying to make guesses about the direction of the underlying asset's value to make a profit.

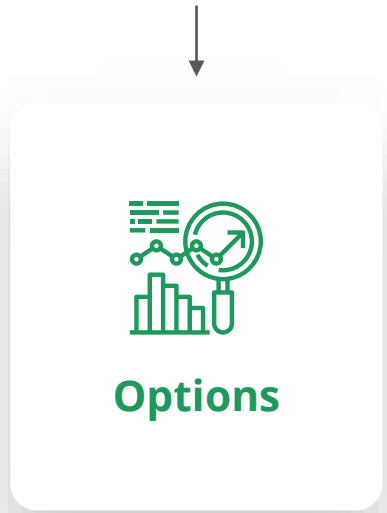
Types of Derivative Contracts

Common derivative contracts include forwards, futures, options, and swaps.

Forward Commitment



Contingent Claims



Forward Contracts

What is a Forward Contract?

A forward contract is an agreement between two parties to exchange an asset for a pre-specified price on a specific date in the future. Examples include:

Example 1

In one year's time Party A will purchase 8,000 barrels of oil from Party B at $50 per barrel.

Example 2

In one month's time Party A will purchase $500,000 USD from Party B for $675,000 CAD.

Example 3

In five year's time Party A will purchase 600 troy ounces of gold from Party B for $900,000 USD.

What is the Purpose of a Forward Contract?

Forwards are over-the-counter contracts. Although they can be used for speculating, the customizability makes forwards very useful for hedging.

Hedging

VS

Speculating

For example, industries that heavily rely on a commodity such as an airline on jet fuel, can hedge the price of fuel using forwards to reduce volatile prices.

Components of a Forward Contract

Important components of a forward contract will include:

1. Underlying Asset

2. Delivery Date

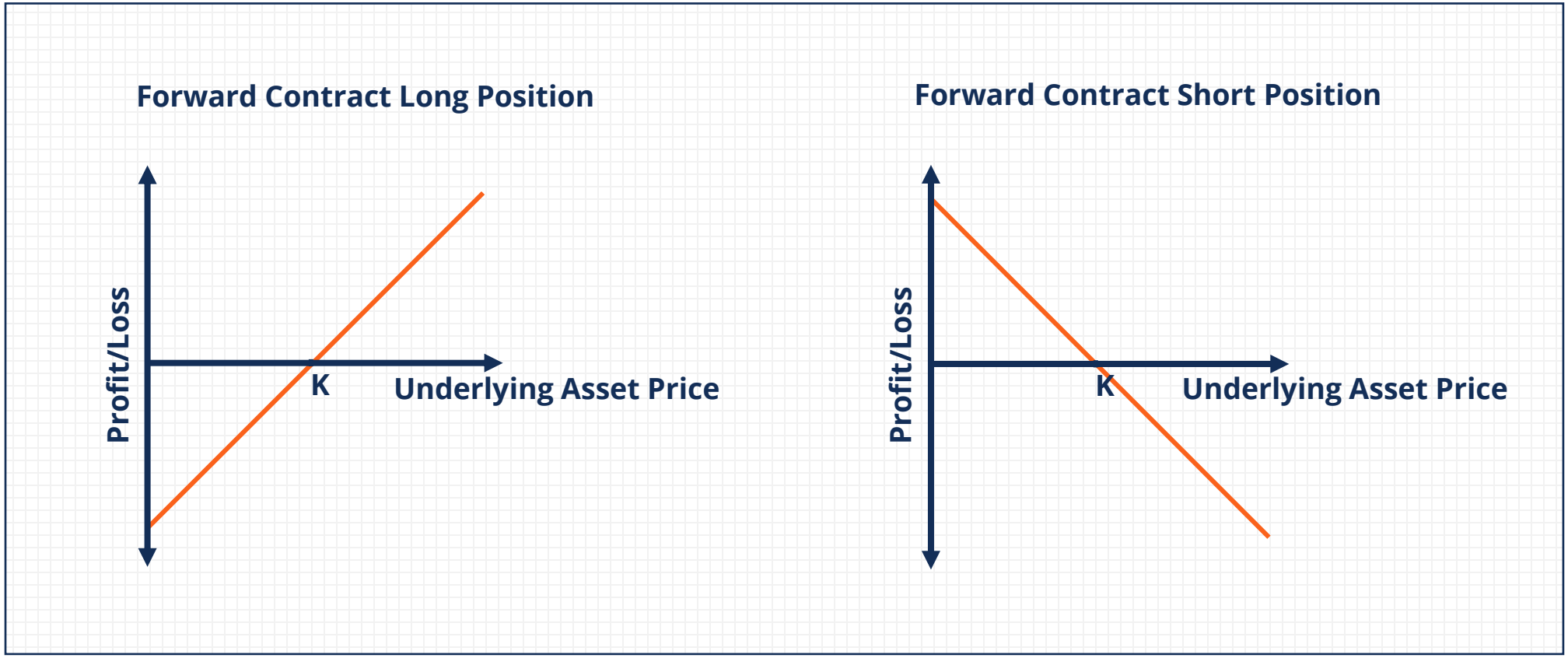
3. Specified Price

4. Quantity

5. Type of Delivery

Forward Contract Profit/Loss (Pay-off) Diagrams

At expiration, a long position benefits the higher the price of the underlying asset. A short position benefits the lower the price of the underlying asset.

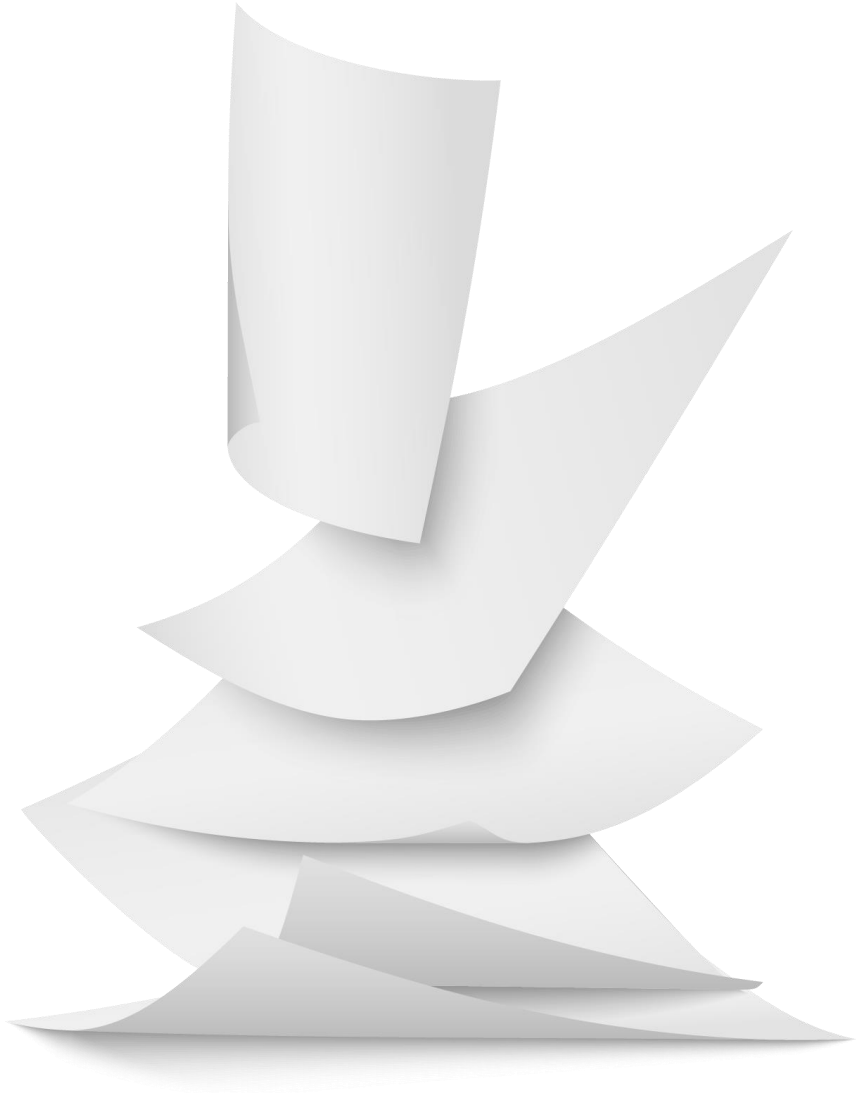


Forward Contract – Worked Example

Let’s consider a situation involving a forward contract.

Read the following scenario:

- A party needs 10,000 barrels of oil in 3 months.
- They are worried about the price of oil rising, so they enter into a forward contract to purchase 10,000 barrels at $50/barrel in 3 months time.
- At expiration, the spot price of oil is $55/barrel.
- How much money was saved from entering into the forward contract?
- What if the spot price had instead dropped to $40?



Forward Contract – Worked Example

Let’s consider a situation involving a forward contract.

Read the following scenario:

A party needs 10,000 barrels of oil in 3 months. They are worried about the price of oil rising, so they enter into a forward contract to purchase 10,000 barrels at $50/barrel in 3 months time. At expiration, the spot price of oil is $55/barrel. How much money was saved from entering into the forward contract? What if the spot price had instead dropped to $40?

Excel Example

Futures Contracts

What is a Futures Contract?

A futures contract is similar to a forward contract. It is an agreement to exchange an underlying asset for a pre-specified price at a specified date in the future.

The major differences however include:

01 **Futures contracts have standardized contract terms.**

02 **Futures contracts are traded on exchanges rather than over the counter.**

03 **Futures contracts involve margins.**

What is the Purpose of a Futures Contract?

Futures contracts are often used for hedging, however the liquidity of futures contracts and the ability to leverage through margins makes futures attractive for speculating.

Hedging

VS

Speculating

Components of a Futures Contract

A futures contract will generally have the following important components:

1. Underlying Asset

2. Delivery Date

3. Specified Price

4. Contract Size

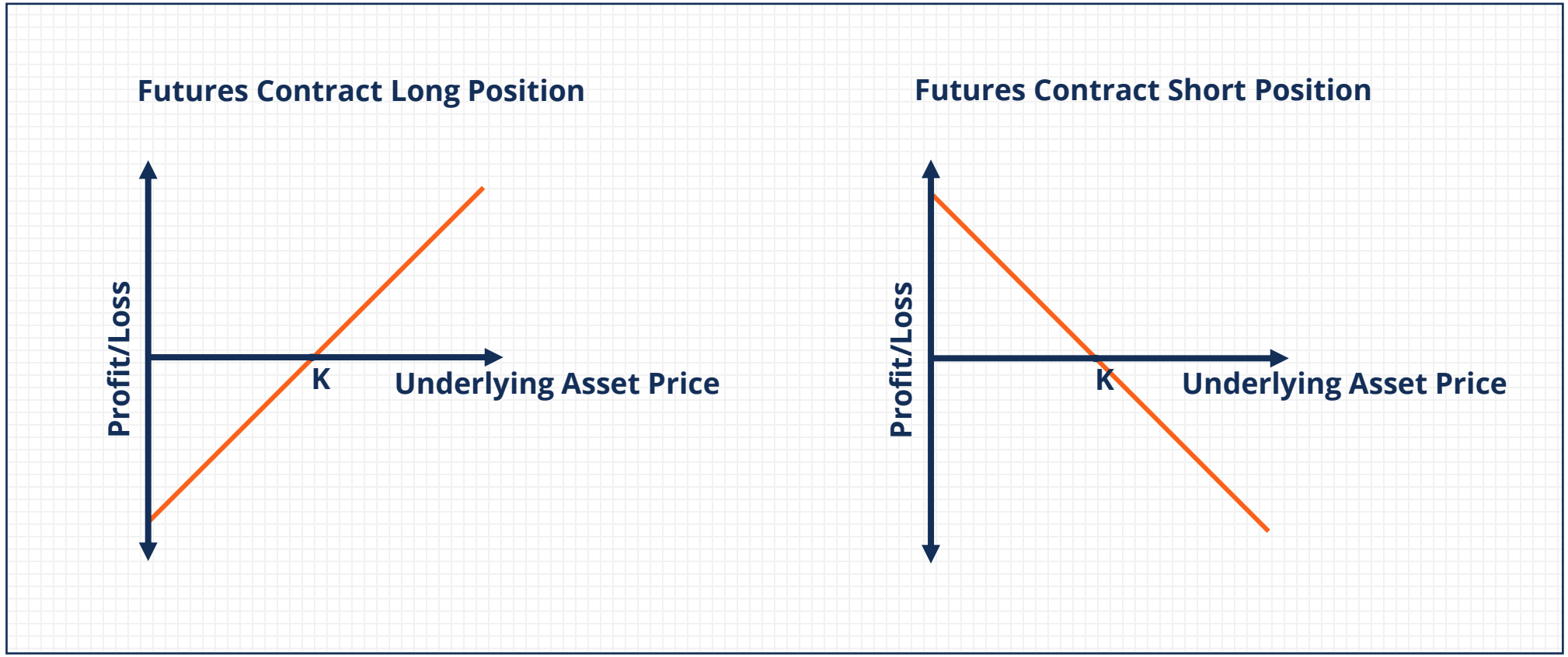
5. Type of Delivery

6. Tick Size

7. Initial and Maintenance Margin

Futures Contract Profit/Loss (Pay-off) Diagrams

Similar to a forward contract, a long position benefits the higher the price of the underlying asset. A short position benefits the lower the price of the underlying asset.



Futures Contract Example

GCG0 1518.80 -2.90 i1518.30/1518.50i 11x5 Prev 1521.70
At 13:50d Vol 2454 Op 1519.00 Hi 1529.40 Lo 1512.00 OpenInt 54176
GCG0 COMB Comdty Page 1/2 Security Description
1) Contract Information 2) Linked Instruments
GCG0 Comdty GOLD 100 OZ FUTR Feb20 CMX-Commodity Exchange, Inc.
3) Notes
** Product specifications link below **
Gold Futures
**Effective July 6, 2015 and pending all relevant CFTC regulatory review periods, CME will close
4) Contracts | CT » Jan-F Feb-G Mar-H Apr-J May-K Jun-M Jul-N Aug-Q Sep-U Oct-V Nov-X Dec-Z

Contract Specifications

Contract Size	100 troy oz.
Value of 1.0 pt	$ 100
Tick Size	0.10
Tick Value	$ 10
Price 1,518.80	USD/t oz.
Contract Value	$ 151,880
Last Time	13:50:45
Exch Symbol	GC
FIGI	BBG00KDSM9X9

Daily Price Limits

Up Limit	N.A.
Down Limit	N.A.

Trading Hours

Exchange Local
Electronic 18:00 - 17:00

6) Related Dates | EXS »

First Trade	Thu	03/29/2018
Last Trade	Wed	02/26/2020
First Notice	Fri	01/31/2020
First Delivery	Mon	02/03/2020
Last Delivery	Fri	02/28/2020

7) Holidays | CDR NM »

5) Price Chart | GP »
Intraday History Curve

Prc Chg 1D	-2.9/-0.191%
Lifetime High	1,571.70
Lifetime Low	1,225.80

Margin Requirements

	Speculator	Hedger
Initial	4,950	4,500
Secondary	4,500	4,500

Futures Contract Example

Futures Contract Example

Contract Size

Futures Contract Example

Futures Contract Example

Futures Contract Example

Mechanics of the Exchange - Margins

A major difference between forwards and futures is that futures contracts are settled daily. A counterparty's margin account is credited or debited as the spot price of the underlying asset changes.

If the margin account of the buyer or seller falls below a certain point, known as the minimum required margin or secondary margin, a margin call will happen. The counterparty is required to deposit more money into the margin account to retain their position.

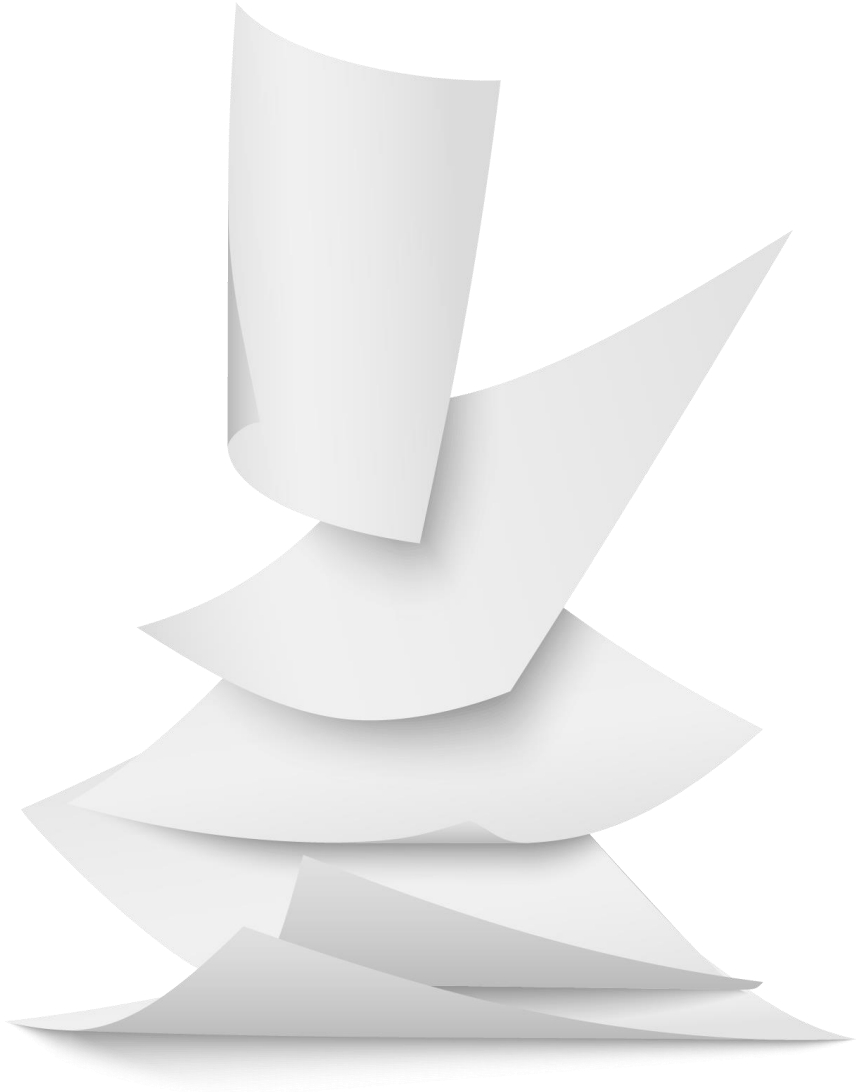
Futures Contract – Worked Example

We are going to calculate the margin requirements for the following contract:

Oil Futures Contract	
Deliver Date	3 days from now
Futures Price	$50.00 USD per barrel
Contract Size	1,000 barrels
Tick	$0.01
Tick Value	$10
Settlement	Physical Delivery
Initial Margin	$5,000
Maintenance Margin	$3,000
Number of Contracts	10

The amount needed to deposit

Minimum balance required



Futures Contract – Worked Example

Exposure: $50/bbl x 1,000 bbls x 10 contracts = $500,000

Initial Margin: $5,000 x 10 contracts = $50,000

Maintenance Margin: $3,000 x 10 contracts = $30,000

Tick: $0.01 per barrel

Tick Value: 1,000 x $0.01 x 10 contracts = $100

	Day 1	Day 2	Day 3 (Expiration)
Settlement Price	$51.10/barrel	$47.50/barrel	$50.20/barrel
Beginning Margin Account	$50,000	$61,000	$50,000
Tick Movement	110	-360	270
Change to Margin Account	+$11,000	-$36,000	+$27,000
Total Before Margin Call	$61,000	$25,000	$77,000
Margin Call	$0	$25,000	0
Ending Margin Account	$61,000	$50,000	$77,000
Deposited Amount	$50,000	$75,000	$75,000
Net Gain(Loss)	$11,000	-$25,000	$2,000

Margin Call

Futures Contract – Worked Example

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How are Futures Prices Calculated?

Imagine that you plan to buy 1,000 barrels of oil in 1 year's time. **There are two strategies you can consider:**

Strategy 1: Buy Now and Hold

You could borrow money to buy the 1,000 barrels of oil at the spot price and hold it for one year. At the one-year mark you would pay back the amount and any interest.

Cost = Spot Price + Carry Cost (Interest + Storage) – Carry Return

Strategy 2: Buy a Futures Contract

You could buy the futures contracts for 1,000 barrels of oil with an expiration in one year's time. The cost in this scenario would simply be the cost of the futures contract.

Cost = Futures Contract Price

How are Futures Prices Calculated?

Let's assume the spot price is $50/barrel, the cost of borrowing is 5%, and the cost of storing 1,000 barrels of oil is $2,000. Let's also assume a 1-year futures contract is priced at $55/barrel (or $55,000 per contract).

Strategy 1: Buy Now and Hold

Cost = Spot Price + Carry Cost (Interest + Storage) – Carry Return

Cost = $50 x 1,000 + ($50 x 1,000) x 5% + $2,000 - $0

Cost = $54,500

Strategy 2: Buy a Futures Contract

Cost = Futures Contract Price

Cost = $55,000

If this were the case, what could an investor do to profit from this situation?

How are Futures Prices Calculated?

If the spot price and futures price are not in equilibrium, there is an arbitrage opportunity:

Strategy 1: Buy Now and Hold

Cost = $54,500

Strategy 2: Sell a Futures Contract

Cost = $55,000

Action	Cash Position
Borrow $50,000	+50,000
Buy 1,000 barrels of oil at the spot price	-50,000
Pay interest and storage costs	-4,500
Sell a futures contract for 1,000 barrels	+55,000
Repay the loan	-50,000
Total	**+$500**

Options

What is an Option?

An option contract gives one party the right, but not obligation, to buy or sell an underlying asset at a specific price by or at a specific date.

If the party that has the right to buy or sell chooses to exercise their option, the counterparty to the contract must deliver. The two basic options include:

Call Option

A call option is the option to **buy** an underlying asset at a specified price in the future.

VS

Put Option

A put option is the option to **sell** an underlying asset at a specified price in the future.

What is the Purpose of an Option?

Options are used for both hedging and speculating purposes.

Since options give the right but not obligation to exercise, investors can use options to speculate while also reducing downside losses.

Long and short positions on calls and puts can be combined in many different ways to serve different purposes.

Hedging

VS

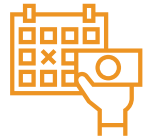
Speculating

Option Examples

Let’s look at examples of both types of options:

Call Option

The right to buy 1,000 barrels of oil at $50 per barrel in one year’s time.



Put Option

The right to sell 600 troy ounces of gold for $1,500 per troy ounce in 6 month.

Components of an Option Contract

Important components of an option will include:

1. Underlying Asset

2. Expiration Date

3. Strike Price

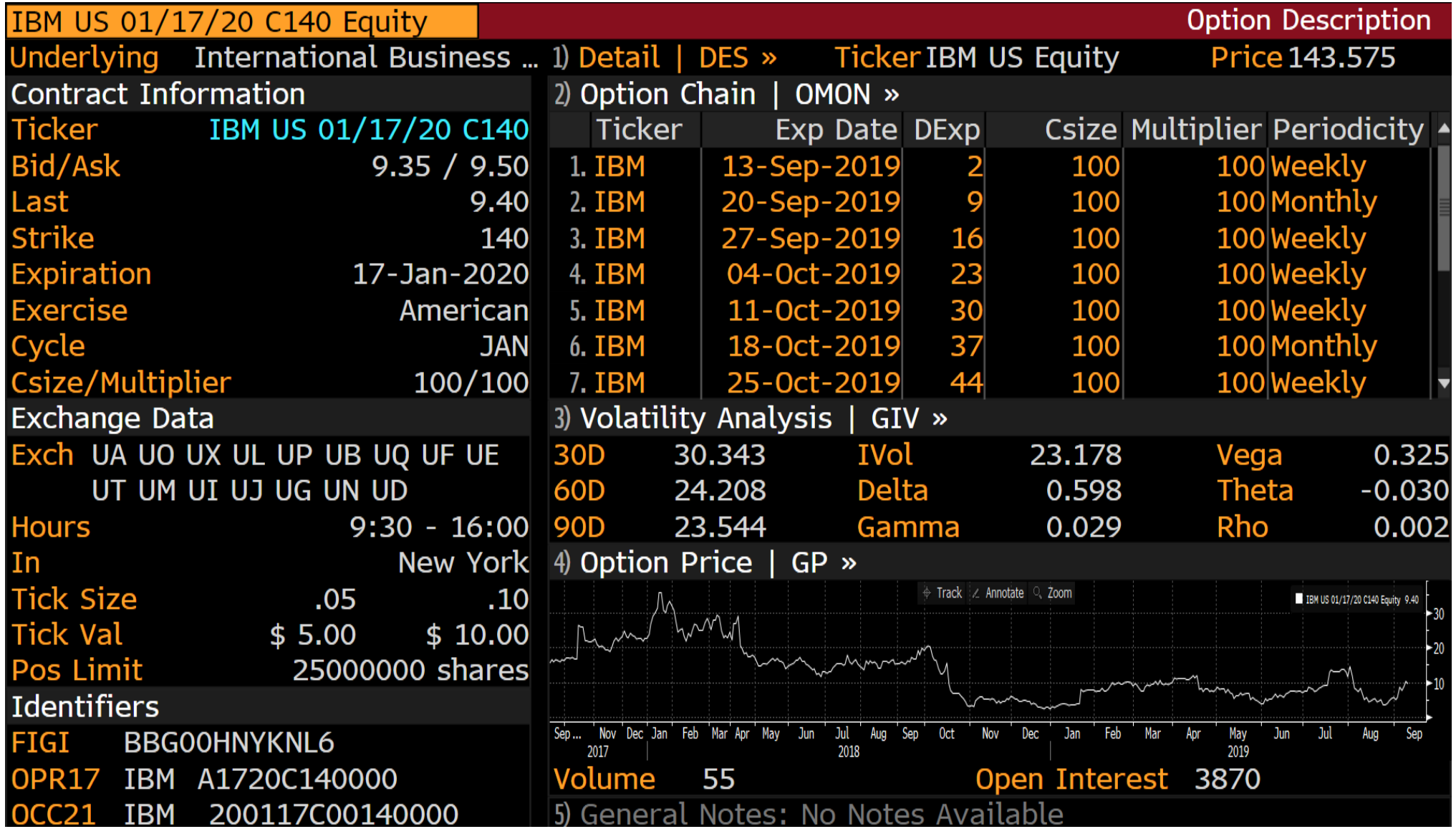
4. Contract Size

5. Type of Delivery

6. Option Premium

7. American vs. European

Bloomberg Call Option Example



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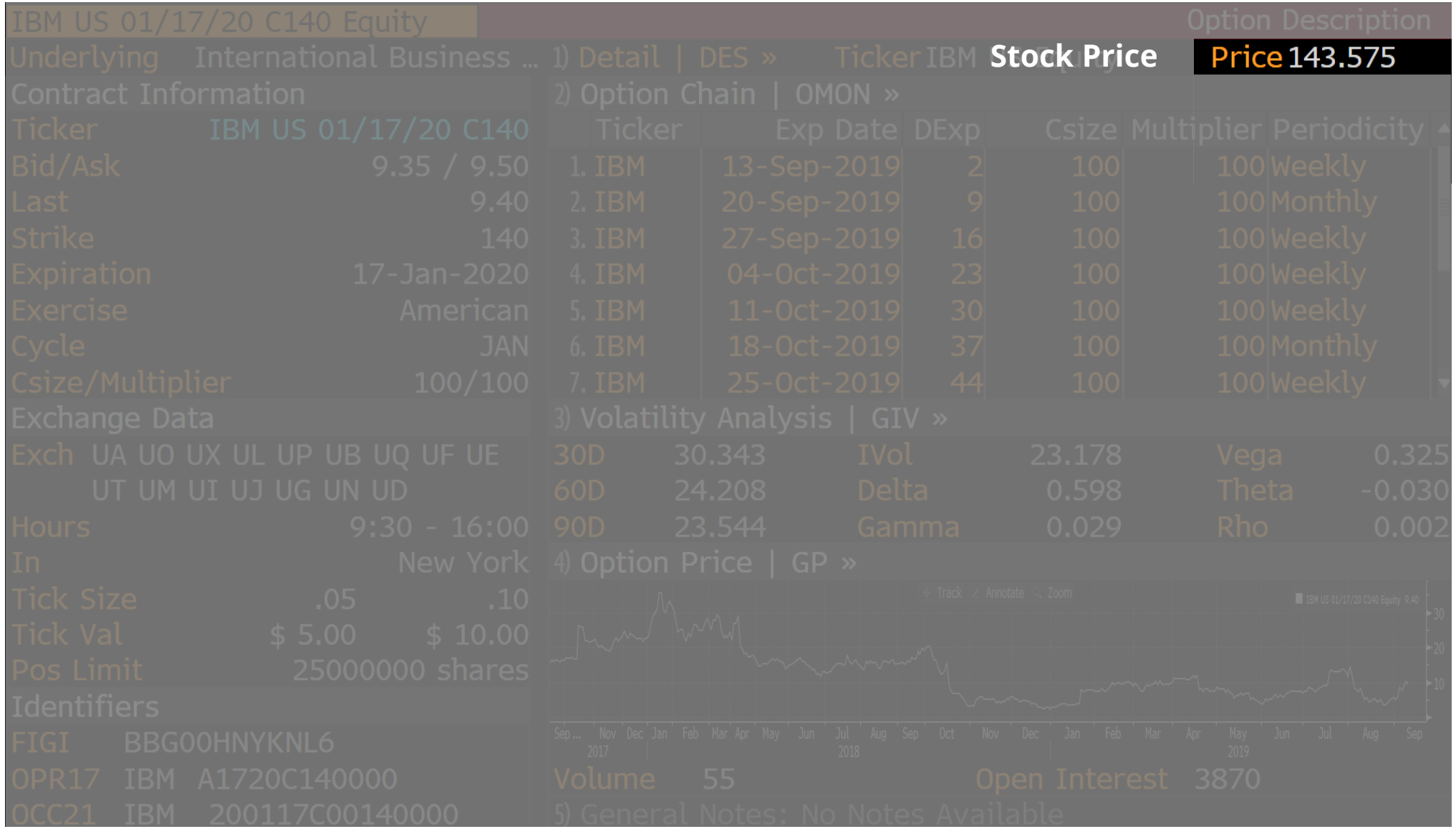

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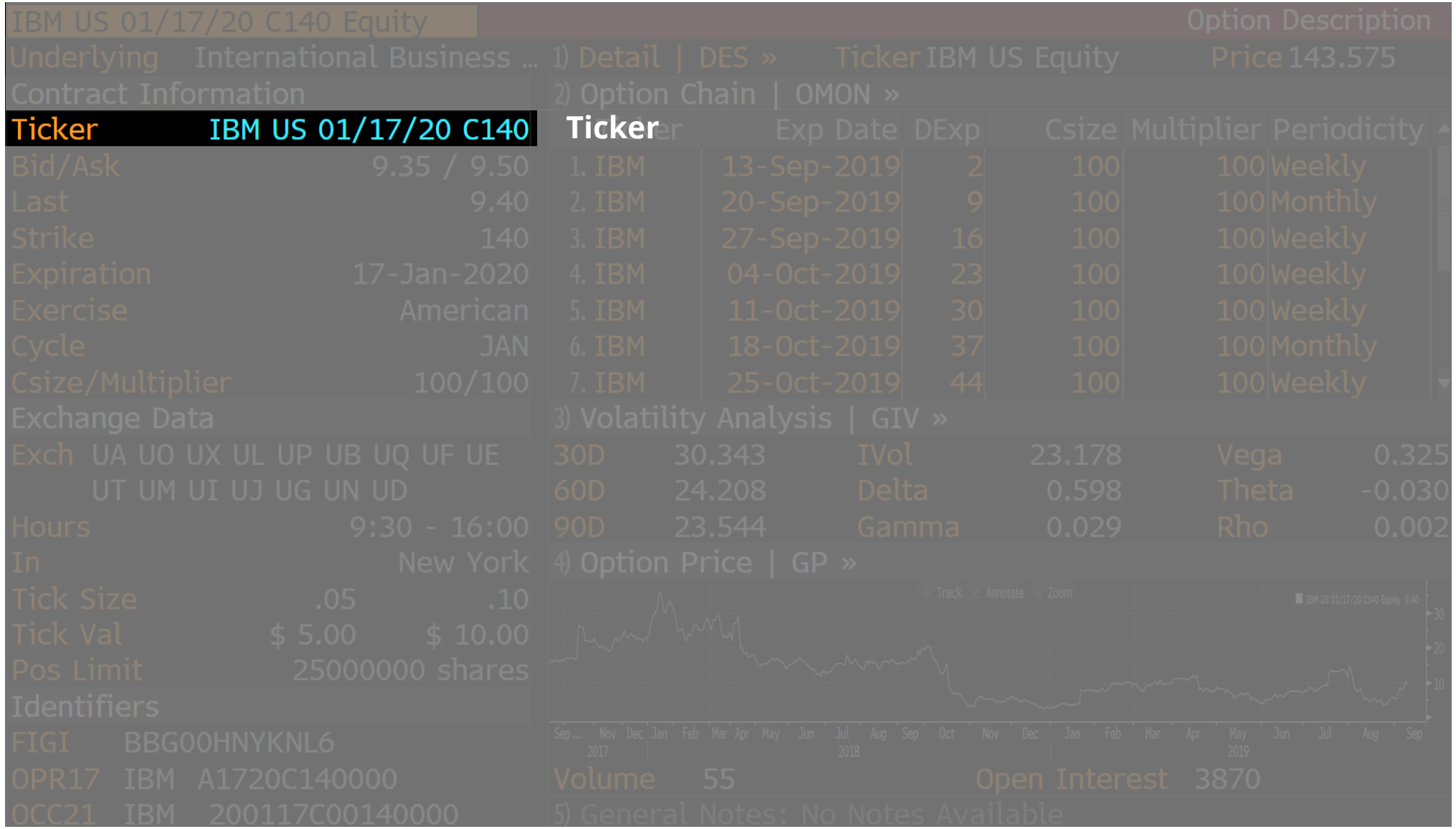

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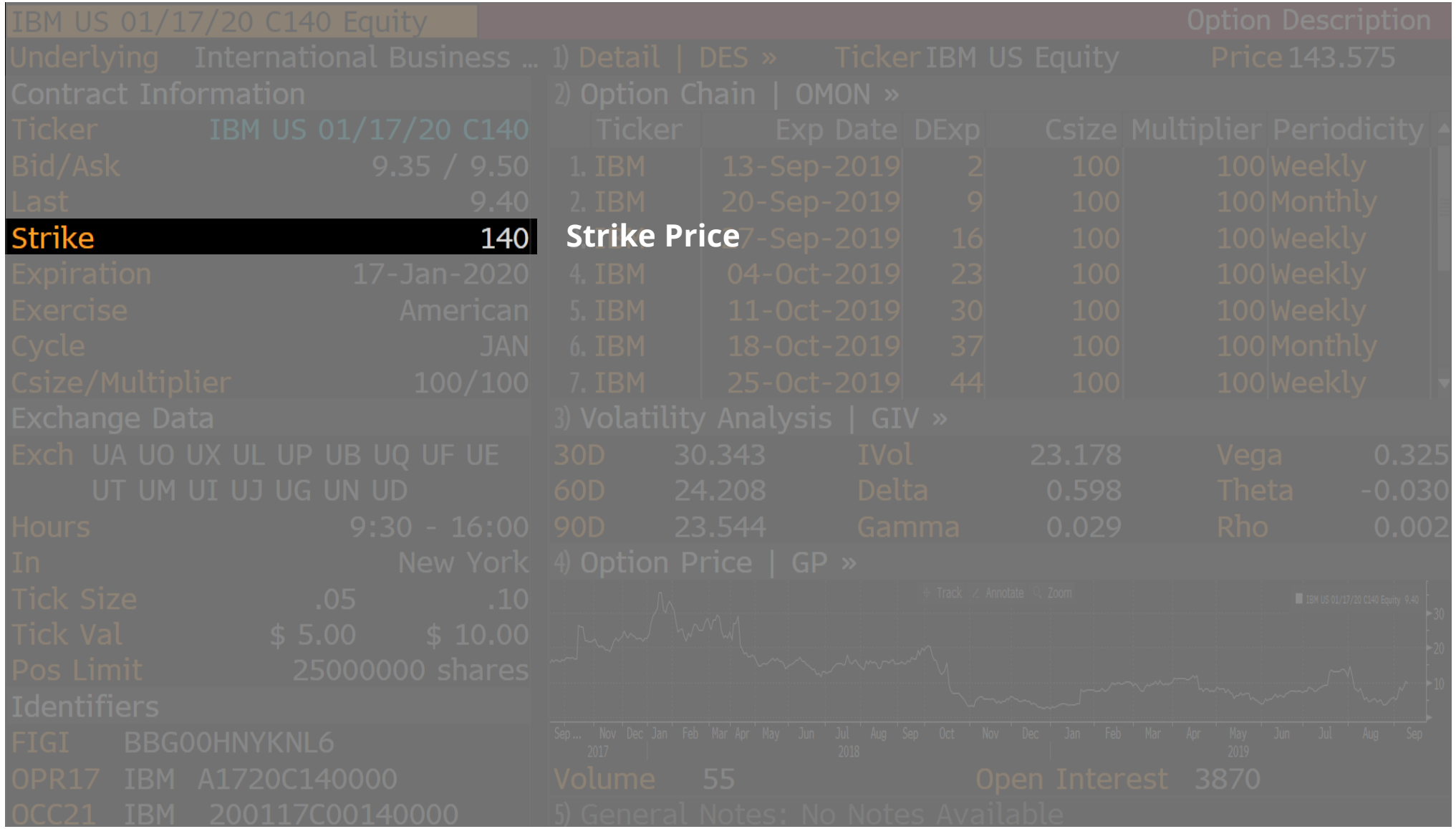

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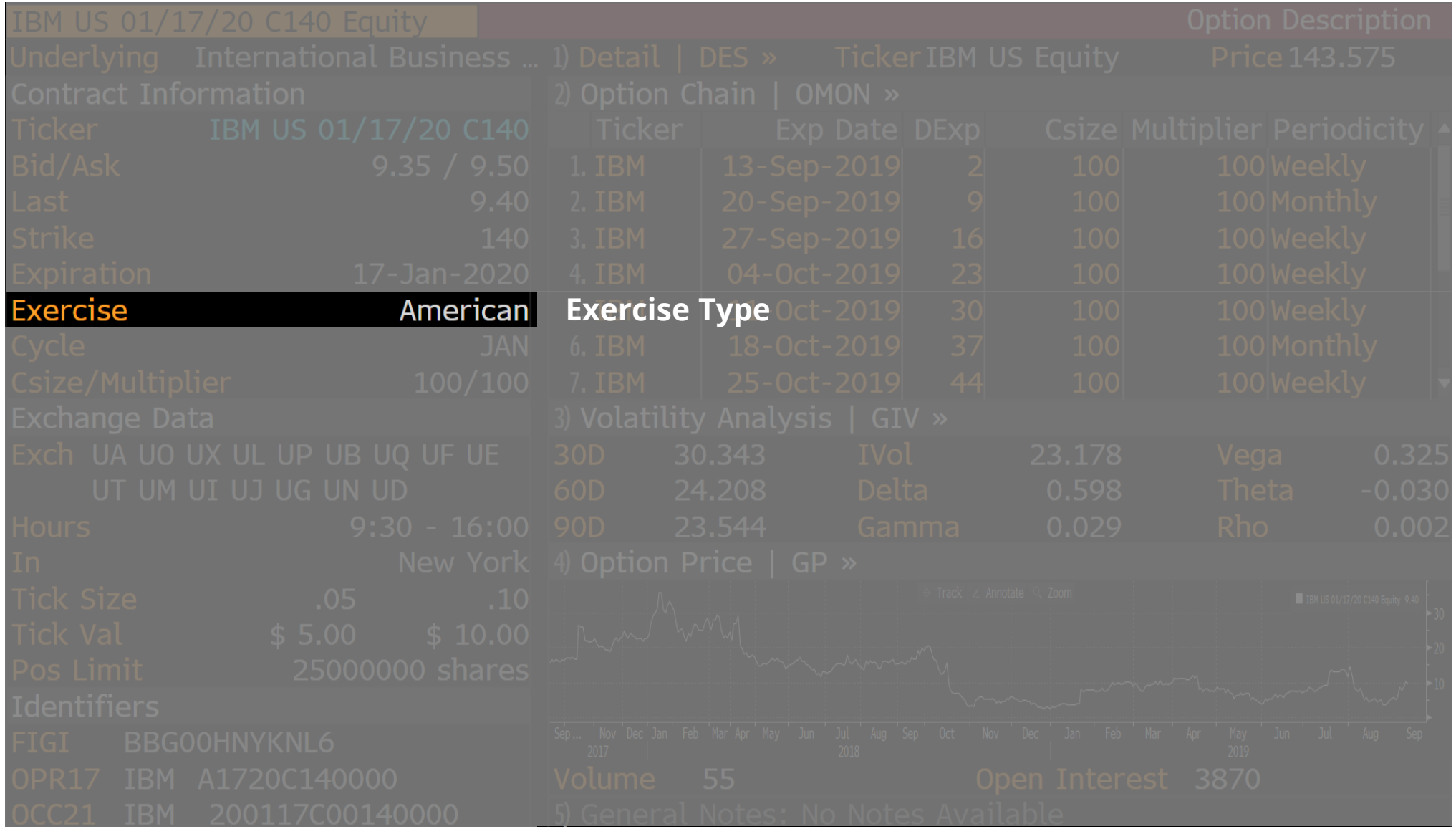

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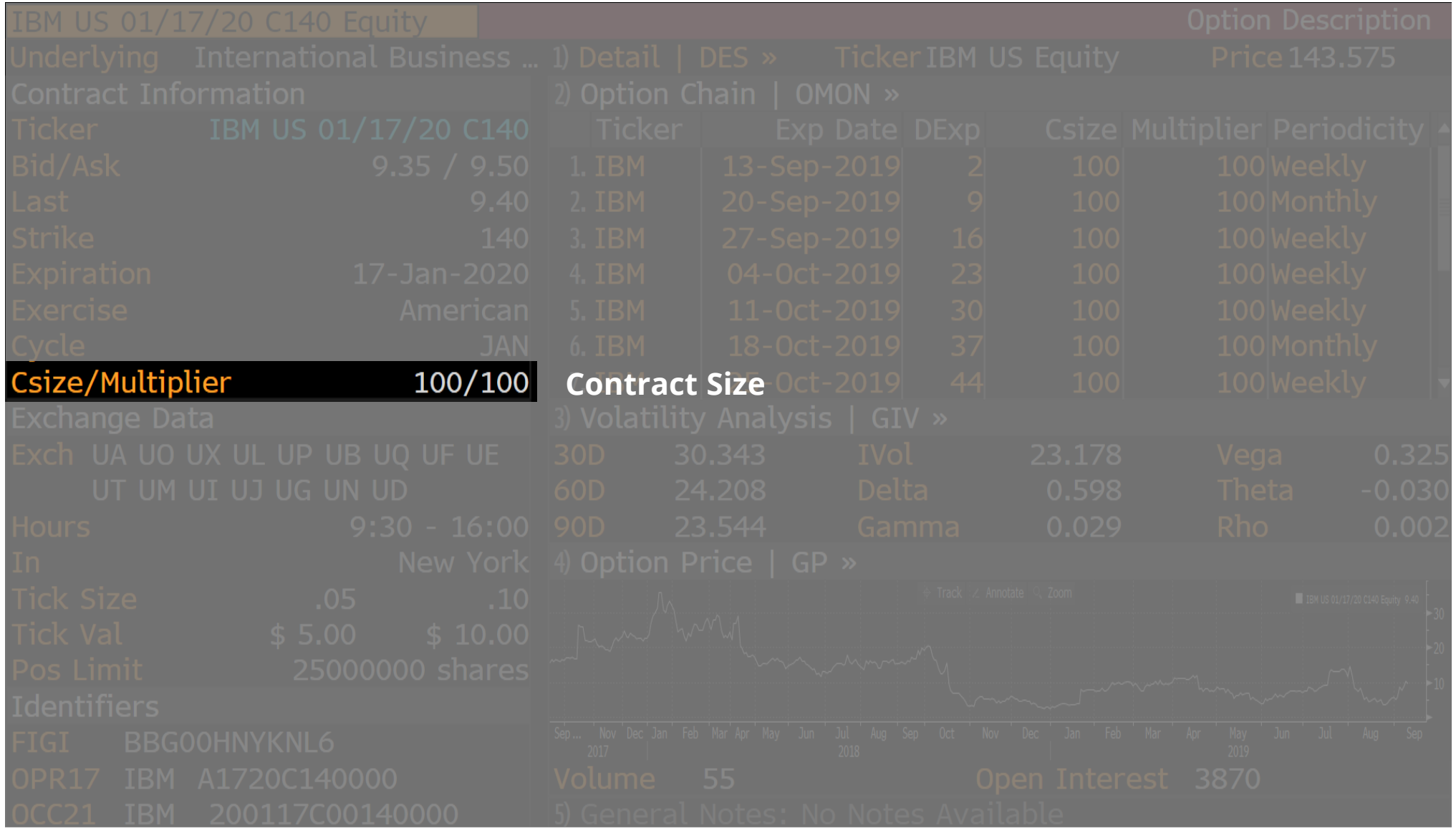
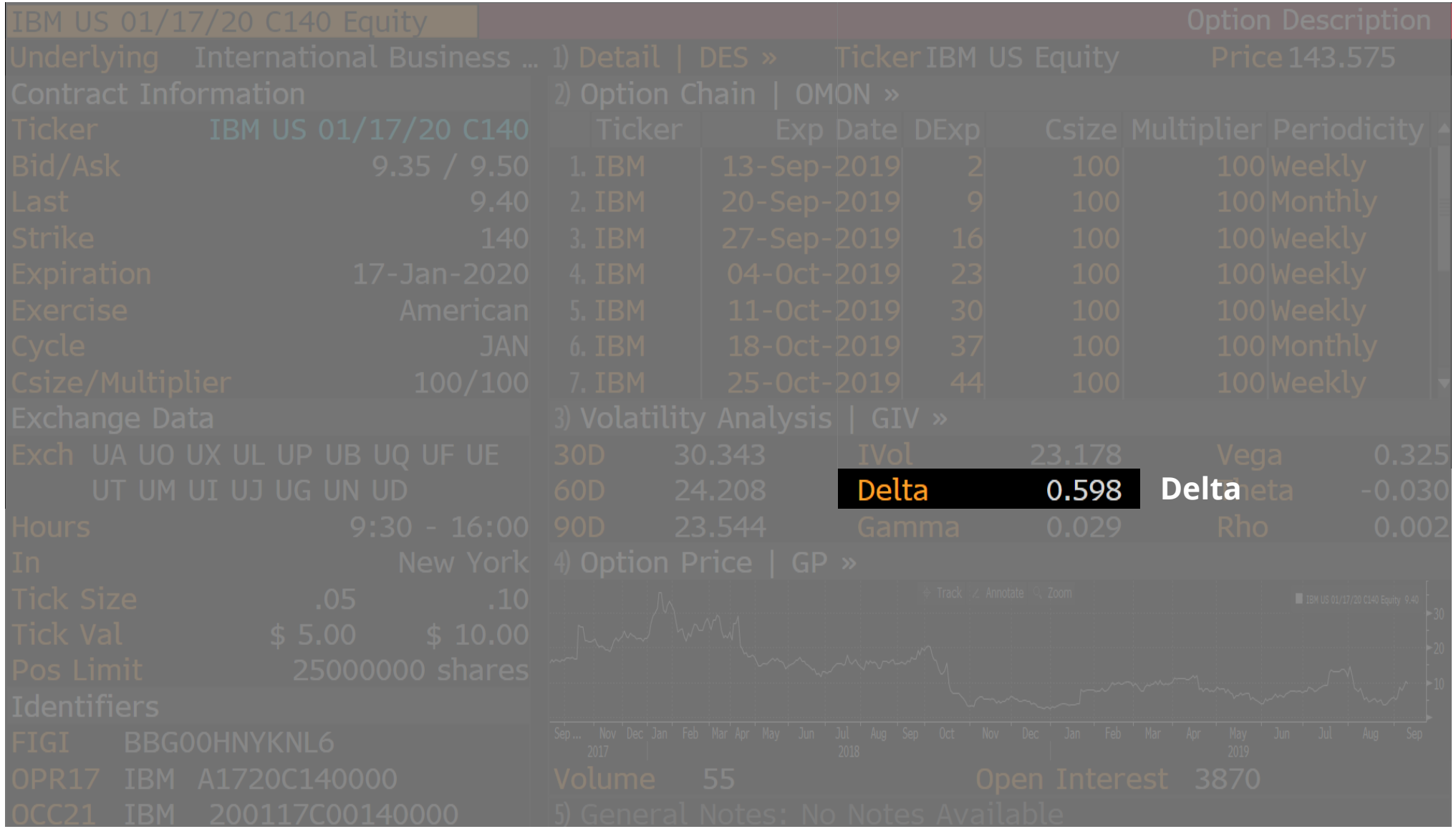


Bloomberg Call Option Example



Bloomberg Put Option Example

IBM US 01/17/20 P140 Equity — Option Description

Underlying International Business … | 1) Detail | DES » | Ticker IBM US Equity | Price 143.54

Contract Information

Ticker	IBM US 01/17/20 P140
Bid/Ask	6.25 / 6.40
Last	6.25
Strike	140
Expiration	17-Jan-2020
Exercise	American
Cycle	JAN
Csize/Multiplier	100/100

Exchange Data

Exch	UA UO UX UL UP UB UQ UF UE UT UM UI UJ UG UN UD	
Hours	9:30 - 16:00	
In	New York	
Tick Size	.05	.10
Tick Val	$ 5.00	$ 10.00
Pos Limit	25000000 shares	

Identifiers

FIGI	BBG00HNYKNK7
OPR17	IBM M1720C140000
OCC21	IBM 200117P00140000

2) Option Chain | OMON »

	Ticker	Exp Date	DExp	Csize	Multiplier	Periodicity
1.	IBM	13-Sep-2019	2	100	100	Weekly
2.	IBM	20-Sep-2019	9	100	100	Monthly
3.	IBM	27-Sep-2019	16	100	100	Weekly
4.	IBM	04-Oct-2019	23	100	100	Weekly
5.	IBM	11-Oct-2019	30	100	100	Weekly
6.	IBM	18-Oct-2019	37	100	100	Monthly
7.	IBM	25-Oct-2019	44	100	100	Weekly

3) Volatility Analysis | GIV »

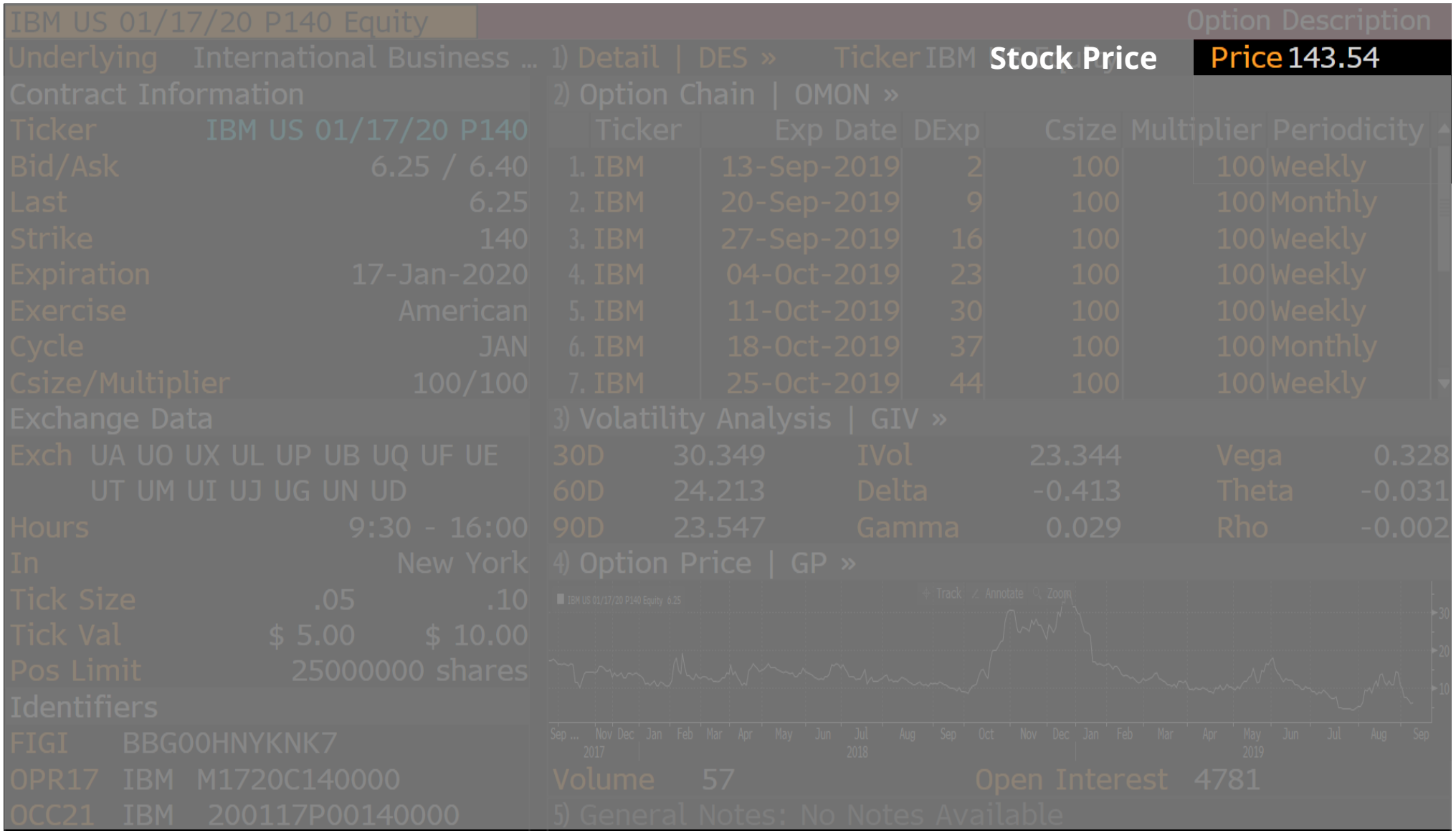
30D	30.349	IVol	23.344	Vega	0.328
60D	24.213	Delta	-0.413	Theta	-0.031
90D	23.547	Gamma	0.029	Rho	-0.002

4) Option Price | GP »

Volume 57 | Open Interest 4781

5) General Notes: No Notes Available

Bloomberg Put Option Example



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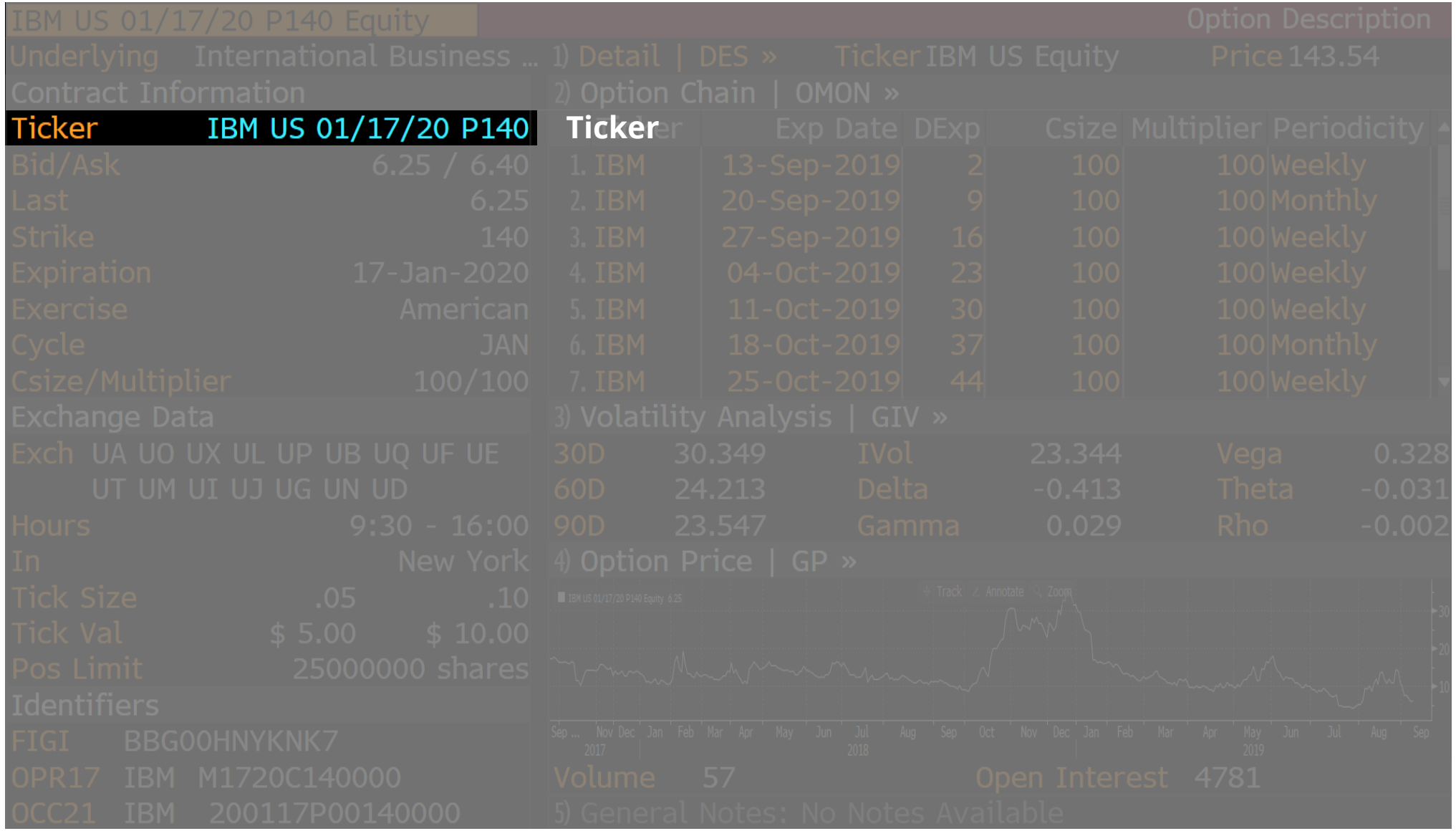

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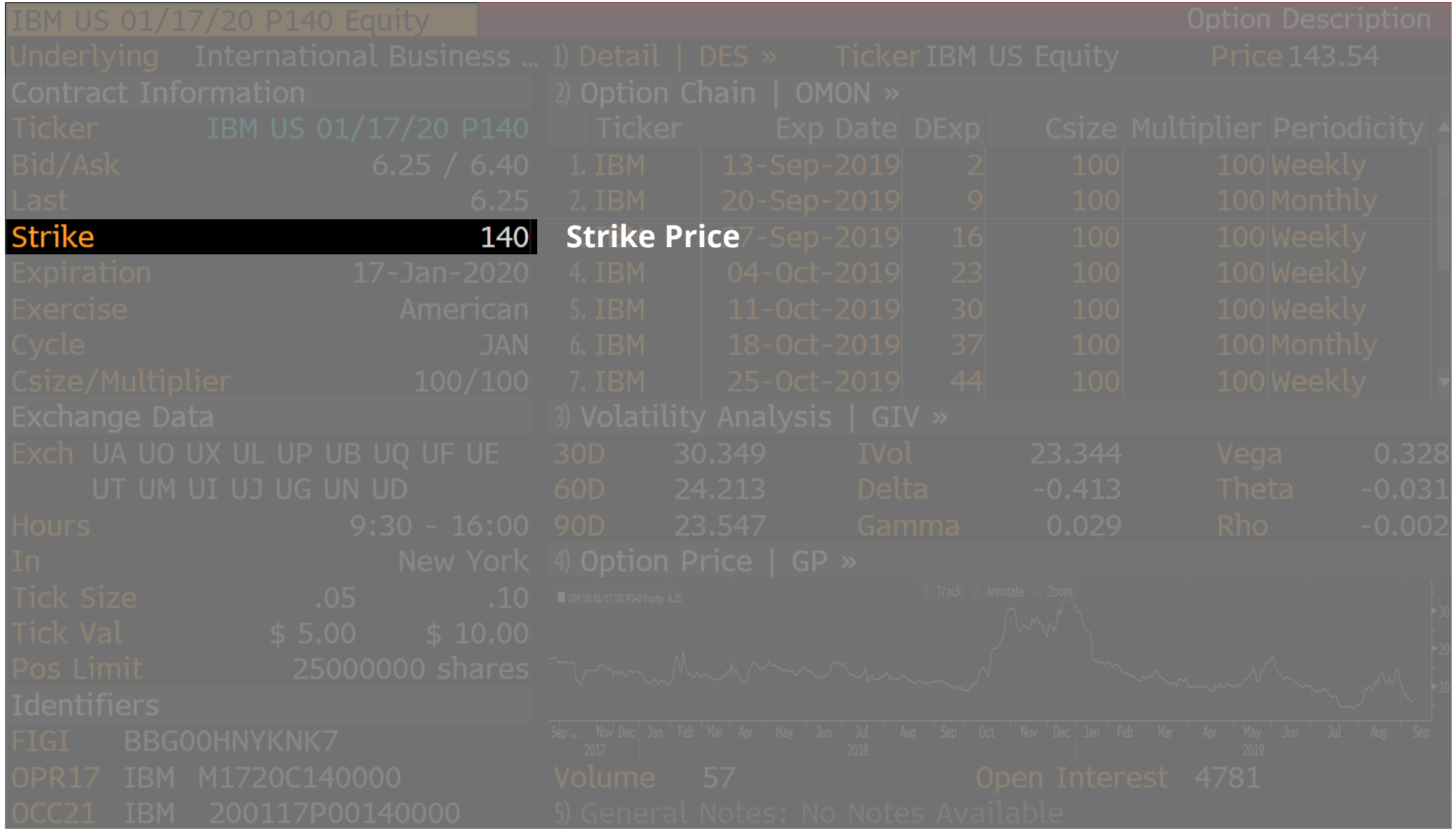

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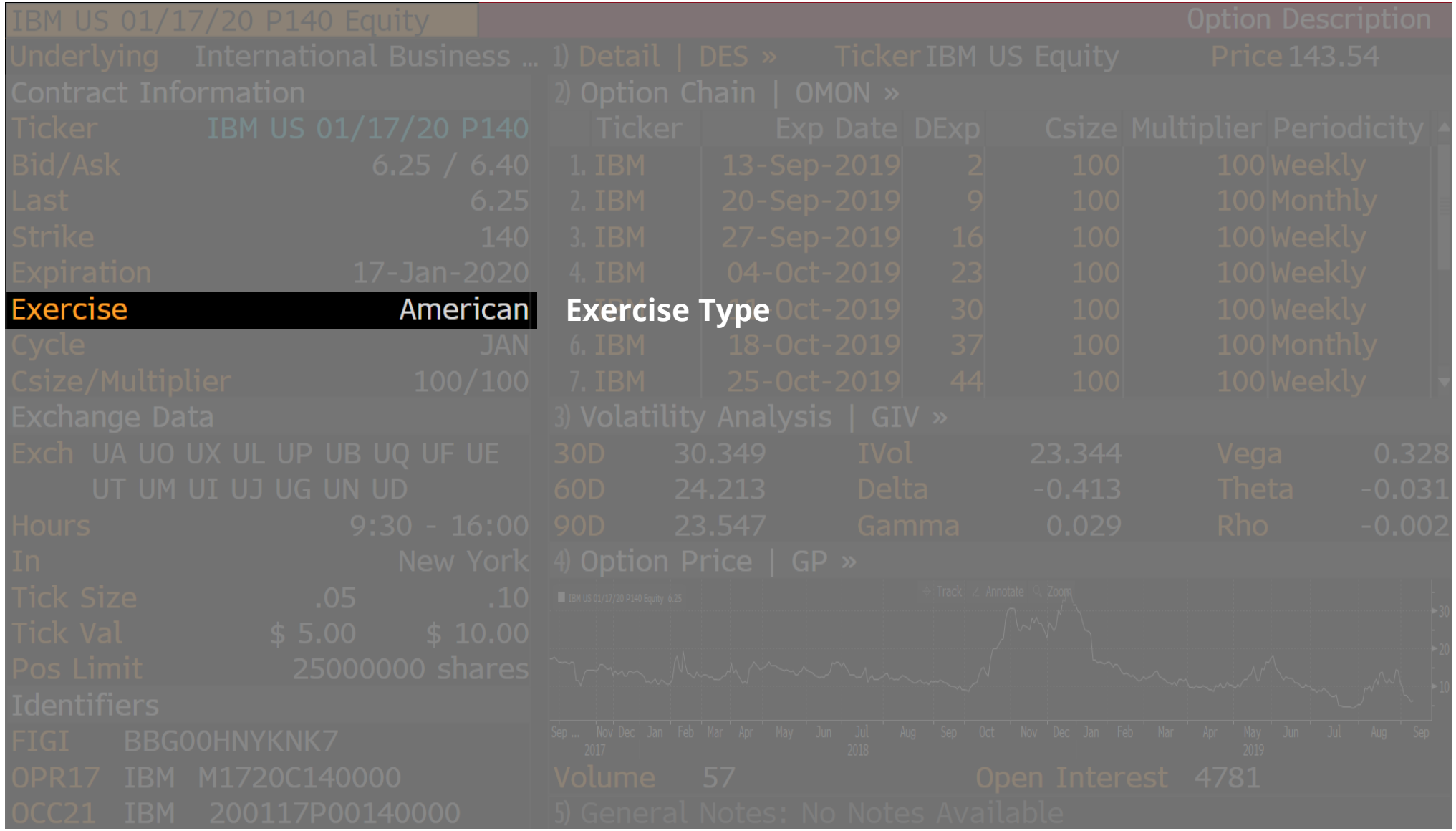
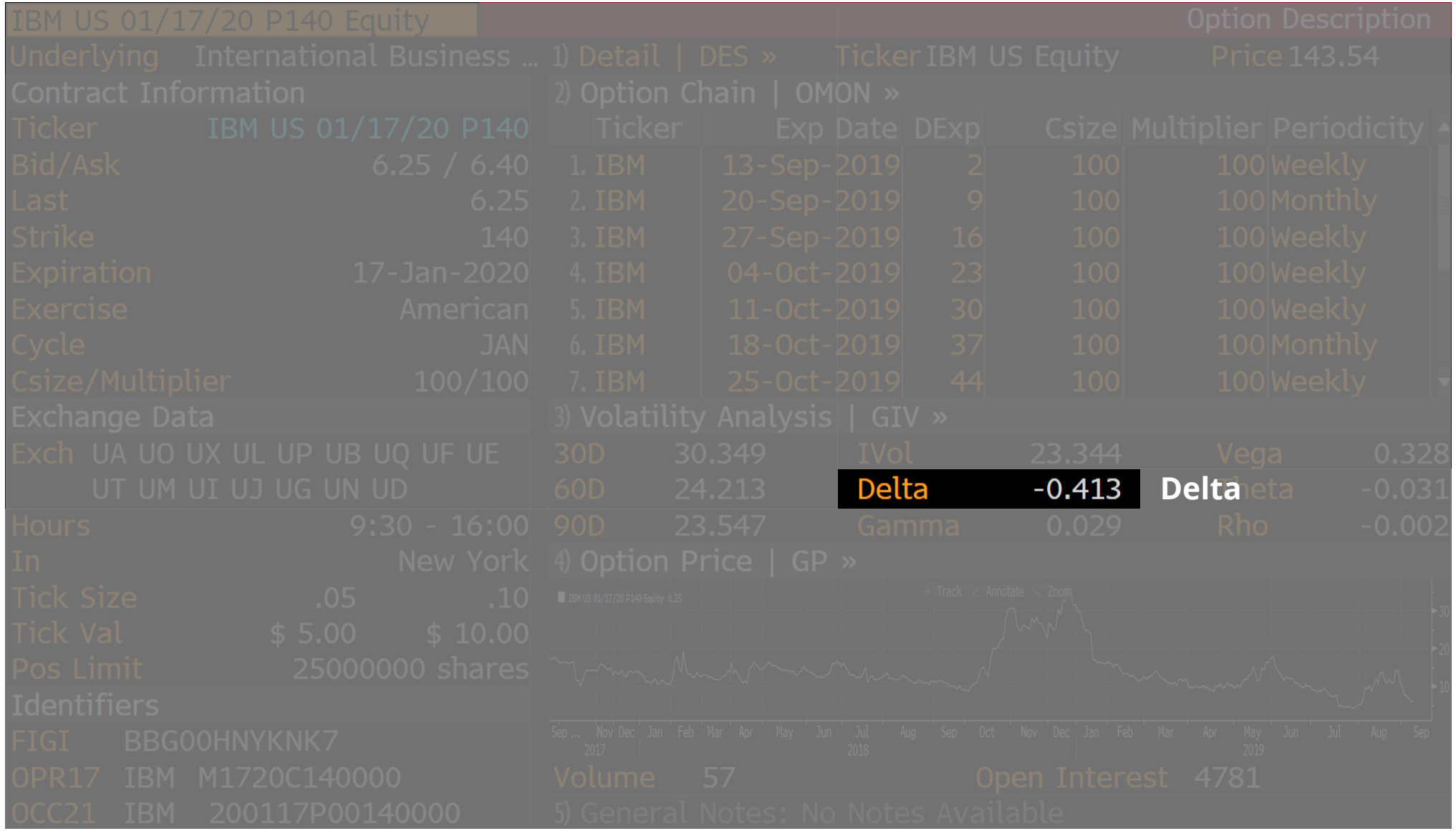
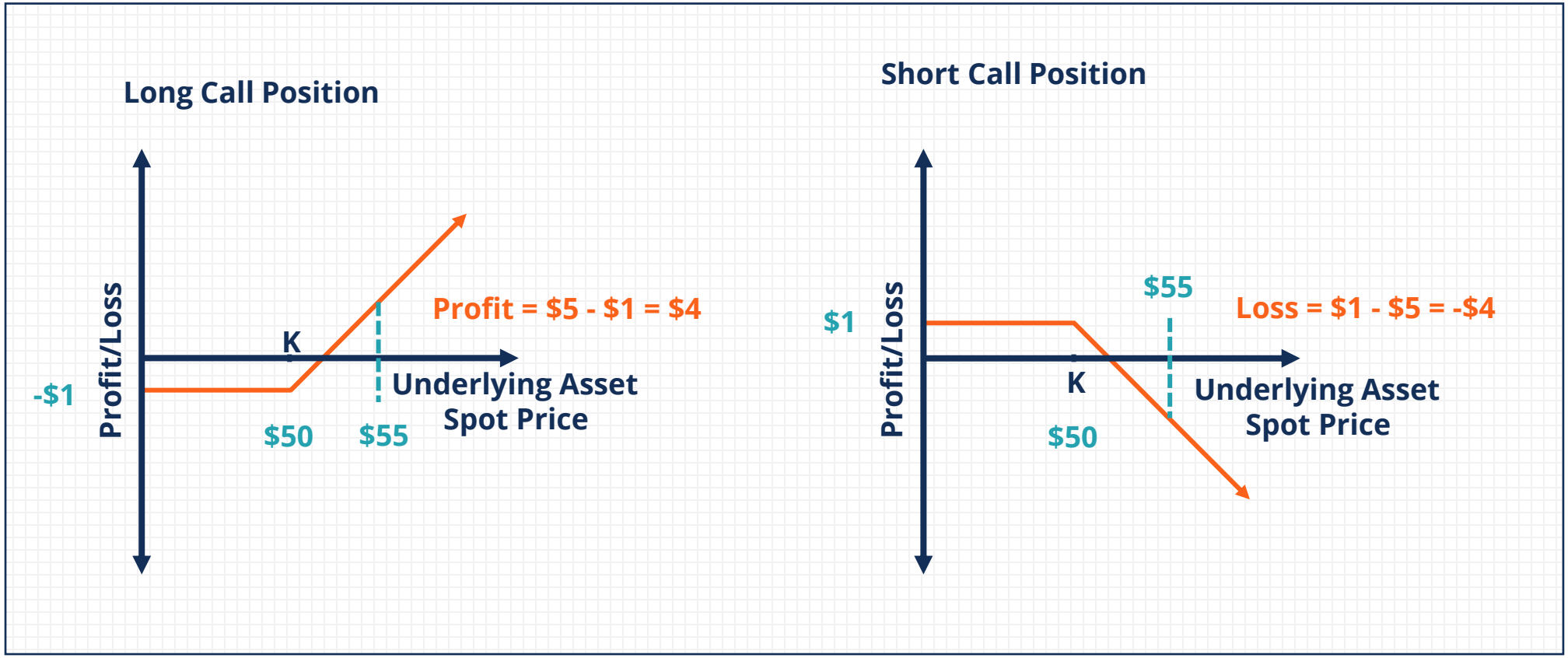


Bloomberg Put Option Example



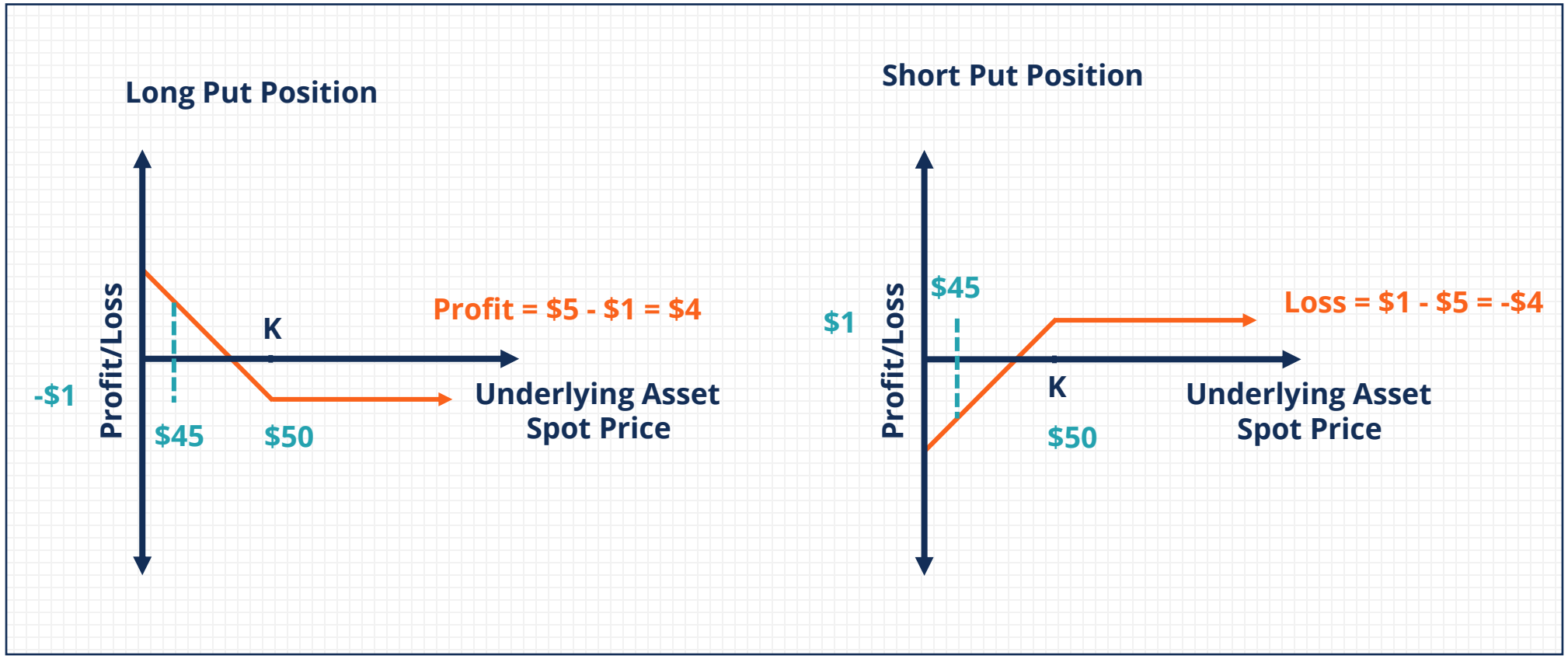
Call Option Profit/Loss (Pay-off) Diagrams

Here we can see the profit/loss diagrams for a long position and short position on a call option.



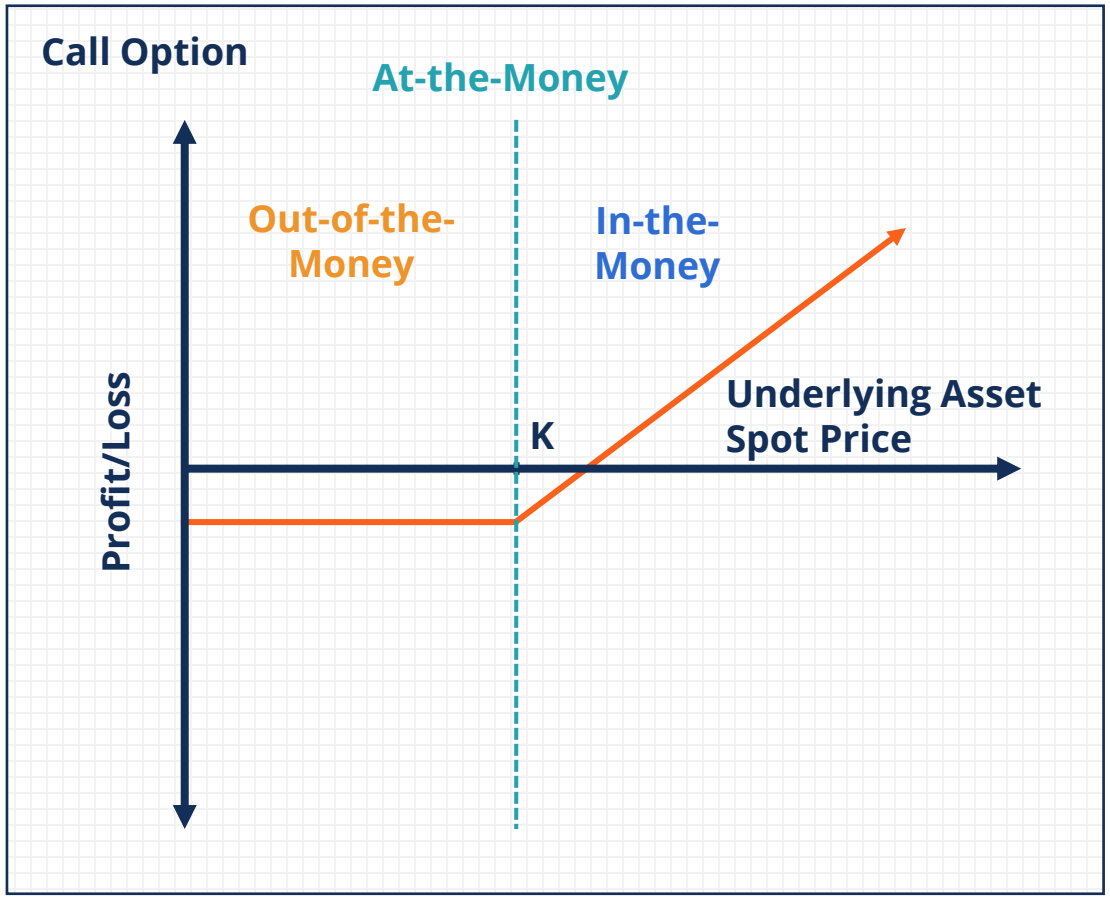
Put Option Profit/Loss (Pay-off) Diagrams

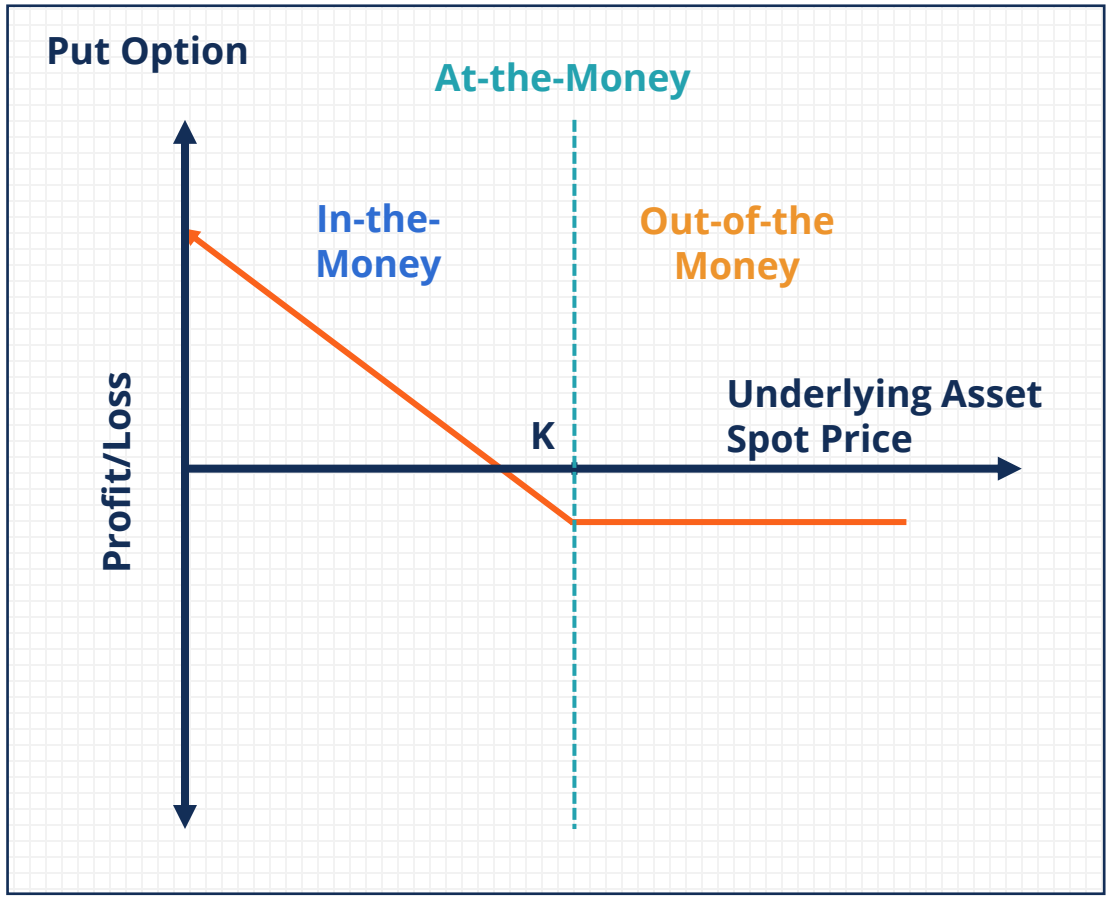
Here we can see the profit/loss diagrams for a long position and short position on a put option.



Moneyness

Moneyness refers to whether an option has intrinsic value by comparing the strike and spot prices.



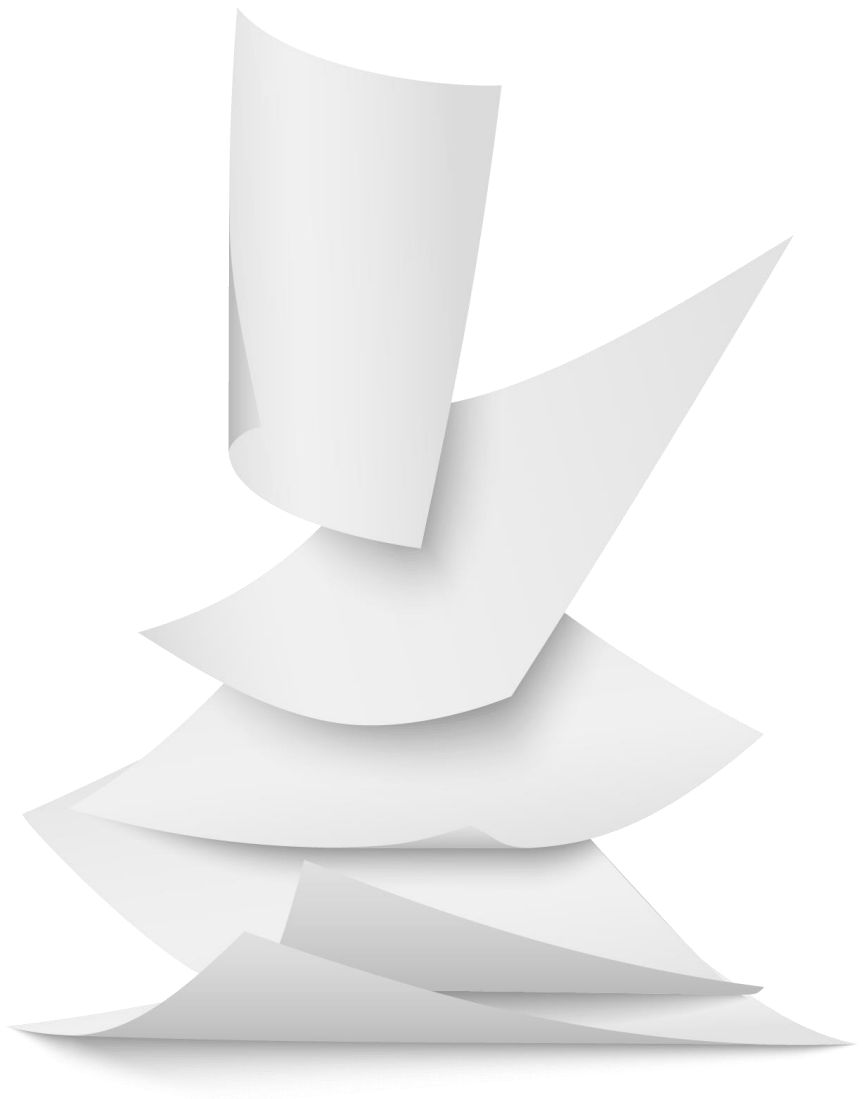


Options – Worked Example

Let’s consider a situation involving the use of an option.

Read the following scenario:

- An investor holds 100 shares of Company A, which is currently trading at $50 per share.
- They believe the stock price will fall soon, and to hedge this risk they decide to purchase 100 put options on Company A’s shares.
- These put options have a strike price of $45 and a premium of $2.
- What is the investor’s profit or loss in the following three scenarios:
    - Scenario 1 – if the stock falls to $45.
    - Scenario 2 – if the stock falls to $40.
    - Scenario 3 – if the stock falls to $0.



Options – Worked Example

The table shows the scenarios where the spot price is $45, $40 and $0.

- Put option premium - $2 per share x 100 shares = $200.
- Original spot price is $50 per share and the strike price is $45 per share.

	Spot price = $45	Spot price = $40	Spot price = $0
Gain/Loss on Stock	-$500	-$1,000	-$5,000
Premium	-$200	-$200	-$200
Gain/Loss on Put Option	$0	$500	$4500
Net Gain/Loss	-$700	-$700	-$700

Options – Worked Example

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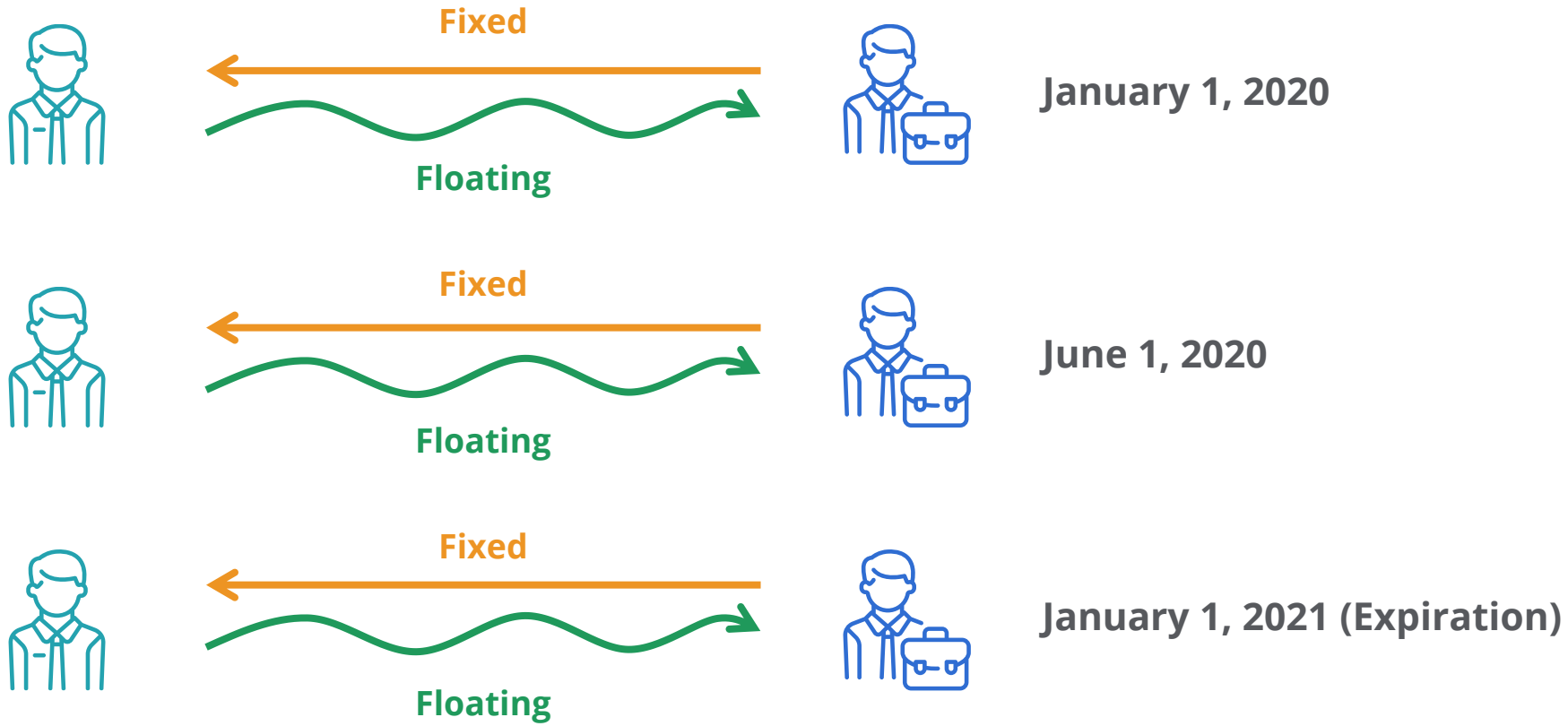
- These put options have a strike price of $45 and a premium of $2.
- What is the investor's profit or loss in the following three scenarios:
- Scenario 1 – if the stock falls to $45.
- Scenario 2 – if the stock falls to $40.
- Scenario 3 – if the stock falls to $0.

Excel Example

Swap Contracts

What is a Swap Contract?

A swap contract is a derivative in which two counterparties exchange cash flows (known as “legs”) over a period of time. Often one leg will be a fixed payment, while the other will be a floating payment.



Components of a Swap Contract

The major components of a swap contract include:

1. Underlying Asset

2. Notional Amount

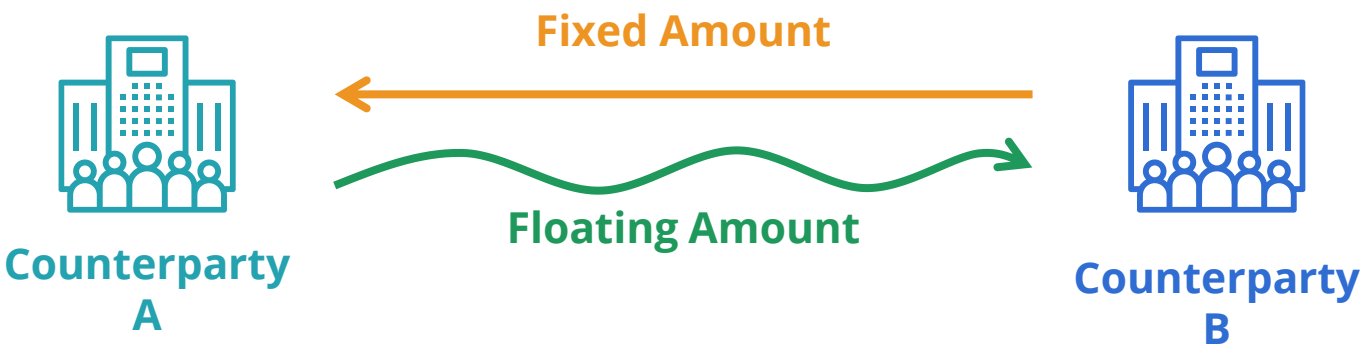
3. Maturity Date

4. Fixed / Floating Rates

5. Payment Frequency

Interest Rate Swap

An interest rate swap “swaps” a fixed rate of interest for a floating rate of interest.



- Two counterparties enter into an interest rate swap with one counterparty paying fixed while the other counterparty pays floating.
- The amount of these payments will be calculated using fixed and floating interest rates and a notional amount that is not swapped.
- Interest rate swaps are often done to take advantage of different comparative borrowing rate advantages of the two counterparties.

Interest Rate Swap Example

Let us now add some numbers to the previous example to see how this works.

- Company A and Company B agree to swap fixed for floating interest rates on a notional value of $1MM.
- The term of the interest rate swap is two years.
- Interest payments will be swapped every six months.
- The fixed rate on the swap is 5.25%.
- The floating rates on the swap (assuming we are looking back) are:

6-Month LIBOR	
Now	5.00%
6-months from now	5.20%
12-months from now	5.30%
18-months from now	5.40%

Interest Rate Swap Example

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Interest Rate Swap Benefits Example

Let’s look at an example of two companies entering into a swap agreement.

Let’s say two companies can borrow at these rates:

Company	Fixed	Floating
A	5.00%	LIBOR
B	6.00%	LIBOR + 0.50%

Assume:

- Company A wants to borrow at a floating rate.
- Company B wants to borrow at a fixed rate.

How can the two companies set up a swap contract that is mutually beneficial?

Interest Rate Swap Benefits Example

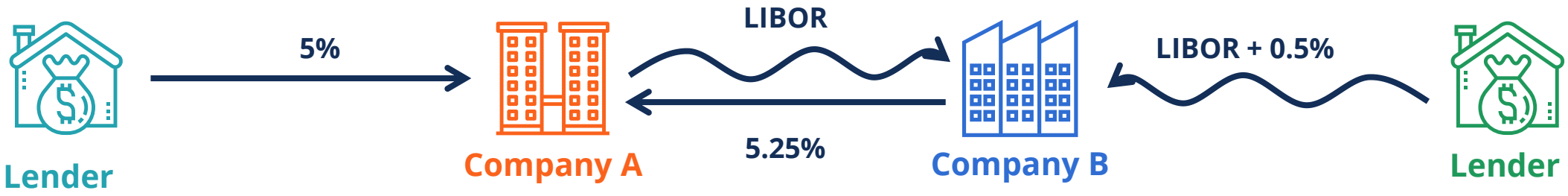
Company A has a comparative advantage against Company B's borrowing rate, therefore a mutually beneficial swap can be arranged:

01 Company A will borrow at their fixed rate of 5% and Company B will borrow at their floating rate of LIBOR + 0.5%.

02 Company A will pay Company B LIBOR on a pre-determined notional amount.

03 Company B will pay Company A a fixed rate of 5.25% on the same pre-determined notional amount.

04 Company A and B will each reduce their costs of borrowing by 25 basis points.



Interest Rate Swap Benefits Example

This swap is mutually beneficial to both counterparties.

	Company A	Company B
Initial Borrowing Cost	5.00%	LIBOR + 0.50%
Amount Paid in Swap	LIBOR	5.25%
Amount received in Swap	5.25%	LIBOR
Net Borrowing Cost	5.00% + LIBOR – 5.25% = **LIBOR – 0.25%**	LIBOR + 0.50% + 5.25% - LIBOR = **5.75%**
Original Borrowing Cost	**LIBOR**	**6.00%**
Savings	**0.25%**	**0.25%**