UNIVERSITY OF PIRAEUS
Department of International & European Studies
MSc in Energy: Strategy, Law and Economics

Special Issues in energy finance & risk management

"Part A: Derivatives in general"
"Part B: Options and hedging strategies"
"Part C: Risk Management Metrics"

Sat, 21 nov 2020

Derivatives in general

What is a derivative?

A derivative is a financial security with a value that is reliant upon or derived from, an underlying asset — a benchmark. The derivative itself is a contract between two parties, and the derivative derives its price from fluctuations in the underlying asset.

The most common underlying assets for derivatives are:

- Stocks
- Bonds
- Commodities (Oil, Gas, Power, Metals)
- Currencies
- Interest rates
- Market indexes

Where to find a derivative?

Organized Exchanges

- The ICE (https://www.theice.com/index)
- Nasdaq (https://www.nasdaq.com/solutions/european-commodities)
- EEX (https://www.eex.com/en/)

Over the Counter (OTC)

- Direct Bilateral
- Indirect Bilateral (via Brokerage)

Pros and Cons

Organized Exchanges	Over the Counter (OTC)
✓ No Counterparty Risk	✗ Extreme Counterparty Risk
✗ Heavily Regulated	✓ No Regulations
✗ High Complexity	✓ Complexity upon Negotiation
✗ Imposes Fees	✓ No extra fees
✗ Need for Collaterals	✓ Collaterals upon Negotiation

Derivatives History

- **4th Millennium BC:** Origins of commerce in Mesopotamia
- **Byzantine Empire:** Contracts for the future delivery of commodities continued to be used in the Byzantine Empire in the Eastern Mediterranean and they survived in canon law in Western Europe
- **During the Renaissance:** Financial markets became more sophisticated in Italy and the Low Countries. Contracts for the future delivery of securities were used on a large scale for the first time in Antwerp and then Amsterdam in the sixteenth century
- **End of 17th century:** Derivative trading on securities spread from Amsterdam to England and France
- **Around 1870:** Financial practitioners developed graphical tools to represent derivative contracts

  - ✓ Derivatives are being widely used to ensure balanced exchange rates for goods traded internationally
  - ✓ With the differing values of national currencies, international traders needed a system to account for differences
  - ✓ Today there are even derivatives based on weather data, such as the amount of rain or the number of sunny/windy days in a region

Examples (hedging)

> imagine a European investor > his investment accounts are all denominated in €
> he purchases shares of a U.S. company in $ > he is exposed to **exchange-rate** risk

If the value of the euro rises, any profits the investor realizes upon selling the stock become less valuable when they are converted into euros.

> How to hedge this risk?

> the investor could purchase a currency derivative to lock in a specific exchange rate!

> Derivatives that could be used to hedge this kind of risk include currency futures

Examples (proprietary trading)

>another investor EXPECTS that € value against $ will FALL (or that $ value against € will rise)

> then he either SELLS € or BUYS $

> if he buys $ for a given future time period then he can be the BUYER of $ which is necessary for our previous investor…

Examples (calculations)

Investor A			
Apple Stock	118,64		$
€/$ parity		1,19	
Apple Stock	99,70		€
Buys	10.000		Stocks
Value	1.186.400,00		$
Value	996.974,79		€
Scenario with EUR up and APPLE up			
Future €/$ Parity		1,30	
and			
Apple Stock UP	130,00		$
Then			
Profit from Stock	113.600,00		$
BUT			
Real Value in €	87.384,62		€
Value with initial Parity	*95.462,18*		€
Loss because of EUR up	8.077,57		€

Common Forms of Derivatives

- **Futures**
  - purchase and delivery of an asset at an agreed upon price at a future date. **Futures trade on an exchange, and the contracts are standardized**
- **Forwards**
  - similar to futures, but only **over-the-counter (OTC)**. When a forward contract is created, the buyer and seller may have customized the terms, size and settlement process for the derivative. As OTC products, forward contracts carry a greater degree of counterparty risk for both buyers and sellers
- **Swaps**
  - another common type of derivative, often used to exchange one kind of cash flow with another
- **Options**
  - similar to futures in that it is an agreement between two parties to buy or sell an asset at a predetermined future date for a specific price. The key difference between options and futures is that, with an option, the buyer is not obliged to exercise their agreement to buy or sell. It is **an opportunity only**, not an obligation—futures are obligations. As with futures, options may be used to hedge or speculate on the price of the underlying asset


Options

What is an option *(δικαίωμα προαίρεσης)*?

- the **right,** but not the obligation**,** to buy or sell a stock or a commodity (or an asset in general) at an agreed upon **price and date**

Call Options

Bet asset price goes UP

Put Options

Bet asset price goes DOWN

Understanding options

Option Contract

dd/mm/yyyy

Party A:.....
Party B:.....

- Agree that –

- Style
- Expiration Date
- Strike Price
- Volume
- Premium

Signatures
Party A | Party B

Style of options

American Style

can be exercised at any time between the purchase and expiration date

European Style

can only be exercised on the expiration date

Expiration Date of options

- Options enable the investor not only to bet on UPS and DOWNS of assets but also to bet on WHEN…
- Expiration Date is very important because it determines the Value of the Option (or else the time value – the time value determines the Premium)
- The most famous model for Options pricing is the **Black Scholes Model**

Strike Price

- The strike price determines whether an option should be exercised or not.

It is the price that a trader expects the asset to be above or below by the expiration date.

In example, if a trader is betting that APPLE's stock will rise in the future, he might buy a **CALL** option for a specific month and a particular strike price.

If he is betting that APPLE's stock will fall in the future then he could buy a **PUT** option for a specific month and a particular strike price.

Volume / Premium

- The volume represents the size of the option contract
- The premium represents the value of the option contract (you multiply the volume by the Options Price) – actually your cost (else sunk cost)

Real Example of EUAs Options

Imagine that I expect EUAs price to rise in December 2020.

Then I BUY today 1.000 tons CO_2 @ 26,64 EUR/ton

If it goes UP in December I win

But what if it goes down? How can I hedge this risk?

I can buy a PUT option (the right to sell at given price) with strike price @ 25.00 EUR/ton which premium costs 0.67 EUR/ton

- 1.000 tons x 0.67 EUR/ton = 670EUR which is the value of my security (my sunk cost)

The ICE Report on EUAs options

Options Daily Market Report for ICE-ECX European Emissions
19-Nov-2020

COMMODITY NAME	CONTRACT MONTH				DAILY PRICE RANGE				SETTLE		VOLUME AND OI TOTALS						
	MONTH	STRIKE	P/C	DELTA	OPEN#	HIGH	LOW	CLOSE#	PRICE	CHANGE	TOTALVOLUME	OI	CHANGE	EXER	BLOCK VOLUME	EOO	SPREAD VOLUME
C-Option on EUA Future																	
C	Dec20	25.00	C	0.6917					2.020	-0.670	2,000				2,000	0	2,000
C	Dec20	30.00	C	0.1508					0.230	-0.190	1,550				1,550	0	1,550
C	Dec20	32.00	C	0.0641	0.135	0.135	0.135	0.135	0.090	-0.080	50				0	0	0
C	Dec20	35.00	C	0.0215					0.030	-0.010	1,500				1,500	0	1,500
Call Totals for C:											**5,100**	**0**	**0**	**0**	**5,050**	**0**	**5,050**

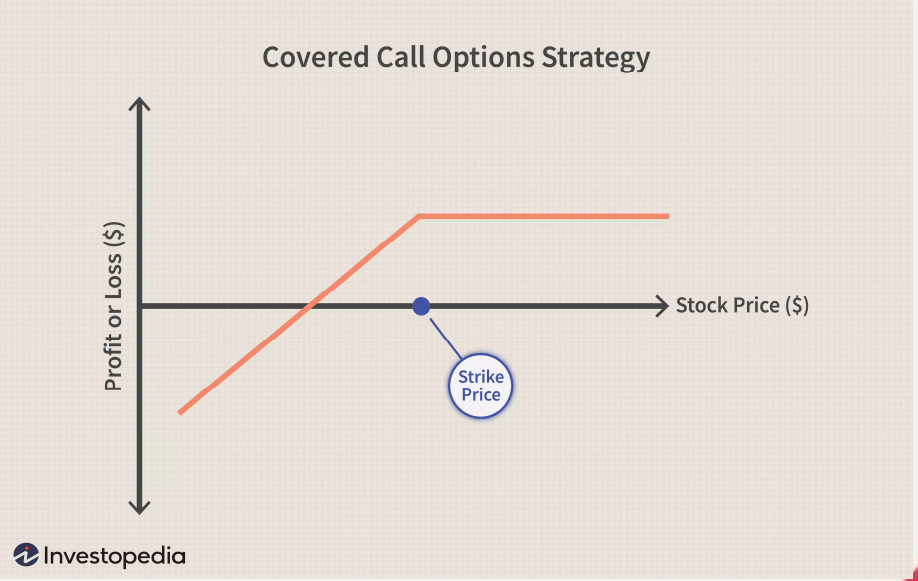
COMMODITY NAME	CONTRACT MONTH				DAILY PRICE RANGE				SETTLE		VOLUME AND OI TOTALS						
	MONTH	STRIKE	P/C	DELTA	OPEN#	HIGH	LOW	CLOSE#	PRICE	CHANGE	VOLUME	OI	CHANGE	EXER	BLOCK VOLUME	EOO	SPREAD VOLUME
C-Option on EUA Future																	
C	Dec20	22.00	P	-0.0829	0.130	0.130	0.130	0.130	0.140	0.010	400				300	0	300
C	Dec20	24.00	P	-0.2058					0.400	0.090	2,950				2,950	0	2,850
C	Dec20	25.00	P	-0.3086					0.670	0.180	5,250				5,250	0	5,100
Put Totals for C:											**8,600**	**0**	**0**	**0**	**8,500**	**0**	**8,250**

Source: https://www.theice.com/marketdata/reports/166

Further hedging strategies

Do you want more??

1. Covered Call
2. Married Put
3. Bull Call Spread
4. Bear Put Spread
5. Protective Collar
6. Long Straddle
7. Long Strangle
8. Long Call Butterfly Spread
9. Iron Condor
10. Iron Butterfly



Smart Tip: USE ALWAYS A SIMPLE EXCEL FILE WITH NUMBERS ON STRATEGIES!!

Source: *https://www.investopedia.com/trading/options-strategies/*

Risk Management Metrics

Credit, Counterparty and Liquidity Risks in the Energy Sector

RISK TYPE	DESCRIPTION	WHERE / WHEN IT OCCURS IN THE ENERGY SECTOR	MITIGATION
Credit	Commercial credit related to products or services delivery and delayed payment	Retail / Wholesales sell of physical energy. Your customer does not pay for supplied energy	Financial Collateral / Credit insurance
Counterparty	Counterparty defaults	In wholesale and trading markets for physical and financial transactions. When we incur in a replacement cost due to our original counterparty default	Financial Collateral / Margining
Financial Liquidity	Misalignment of the economic cycle with respect to the financial cycle	Every sector of the commercial activity	Adequate sizing of credit lines
Market Liquidity	Unexpected reduction in traded volumes on the wholesale markets with consequent widening of the bid-ask spreads.	Supply and Trading activity on physical or financial products	N/A

Credit Risk and Counterparty Risk

- **Credit Risk:** It is the risk that the debtor is unable to fulfill his obligations to pay interest and repay principal. Credit risk is a component of all lending activities and, as such, influences the investment choices of banks, financial intermediaries and bond investors. In general, it is observed that the higher the credit risk, the higher the interest rate demanded by the purchaser of the security as compensation for the greater exposure to this risk

- **Counterparty Risk:** It is the risk that the counterparty with which a negotiation has been concluded, does not fulfill the contractual obligations it had assumed in the manner and / or in the established times. It is among the credit risks and refers in particular to the risks associated with the settlement of derivative contracts traded off regulated markets (ie OTC negotiations). In these cases, lacking an institution with "clearing room" functions, with the negotiation of the derivative, we are exposed to the risk that the counterparty does not honor the commitments undertaken, also and above all before the contractual obligation has become real credit.

Liquidity Risk

- **Liquidity Risk (1):** It is the risk that a company may not fulfill its contractual obligations due to lack of sufficient liquidity (empty cashier). This risk may be caused by a sudden and unexpected misalignment of the economic cycle and the financial cycle of the company itself, not offset by an adequate size of its credit lines and / or current assets.

- **Liquidity Risk (2 – Monetization Risk):** It is the risk that an asset can not be quickly disinvested at an appropriate price. This risk is particularly high for all financial instruments not listed on regulated markets (examples: unlisted bank bonds, shares with low capitalization).

Physical Open Position (Exposure)

- Physical exposure coincides with the open net position against the underlying physical market

- The market defines "long" the net physical exposure deriving from an excess of purchases with respect to sales and "short" the opposite situation (excess of sales).

- Physical exposure is a first measure of analytical risk generated by a deal or a group of deals:
  - exposure to price risk (in the event of a physical market of last resort) or
  - to an imbalance risk

- Physical exposure, depending on the type of deal, can be displayed on the maximum granularity (day / hour) or on intermediate granularities such as the month, the quarter or the season.

Physical Open Position (Example)

	Description	1st Q 2021	2nd Q 2021	3rd Q 2021	4th Q 2021
Deal A)	Long 1.000 barrels Y2021 @ 43 $/bbl	43.000,00			
Deal B)	Long 500 barrels 2nd Half 2021 @ 44 $/bbl			22.000,00	
Deal C)	Short 750 barrels 2nd & 3rd Half 2021 @ 43.50 $/bbl		-32.625,00		
Net Position (in $):		**43.000,00**	**10.375,00**	**32.375,00**	**65.000,00**

Market Risk Measures – Value at Risk (VaR)

The **VaR** v of a portfolio is a measure of risk that allows a statement of the type: in the **next n days,** with **probability α,** the change in the value of the portfolio will be higher than v (euro) - that is with probability 1-α the portfolio value could be lower than v (euro)

It answers the following questions:

- "What is my worst-case scenario?" or
- "How much could I lose in a really bad month?

Value at Risk 3 Components

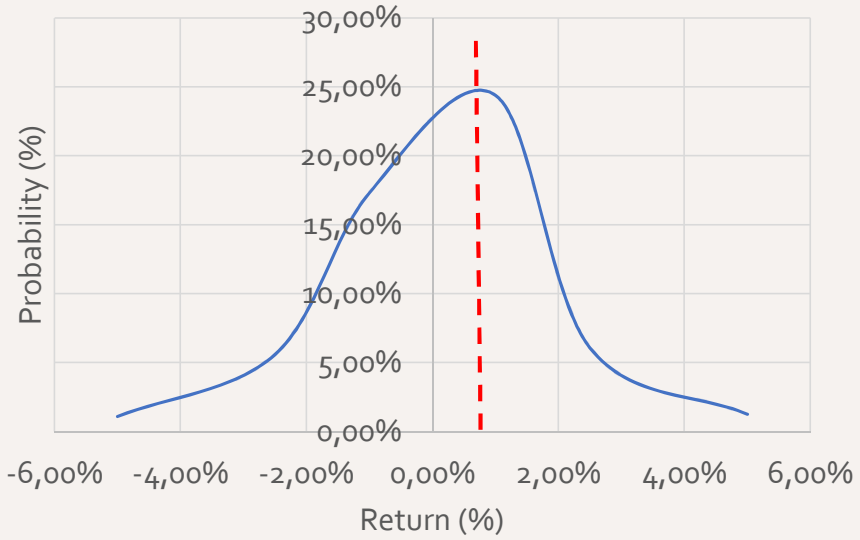
1. a time period (day, month, year)
2. a confidence level (95% or 99%)
3. a loss amount (or loss percentage)

Value at Risk (VaR) 3 Calculation Methods

1. The historical one

The historical method simply re-organizes actual historical returns, putting them in order from worst to best. It then assumes that history will repeat itself, from a risk perspective.

- Imagine you had daily returns from APPLE's stock since year 2015
- You would then have more than 1.258 'observations'
- You would then see that:



Value at Risk (VaR) 3 Calculation Methods

2. The Variance-Covariance Method

This method assumes that stock returns or our asset's returns are normally distributed. In other words, it requires that we estimate only two factors:

- an expected (or average) return and
- a standard deviation

The idea behind the variance-covariance is similar to the ideas behind the historical method - except that we use the familiar normal distribution curve instead of actual data. The advantage of the normal curve is that we automatically know where the worst 5% and 1% lie on the curve. They are a function of our desired confidence and the standard deviation.

Confidence	# of Standard Deviations (σ)
95% (high)	- 1.65 x σ
99% (very high)	- 2.33 x σ

Value at Risk (VaR) 3 Calculation Methods

3. Monte Carlo Simulation

For most users, a Monte Carlo simulation amounts to a "black box" generator of random, probabilistic outcomes. It involves developing a model for future stock or other asset price returns and running multiple hypothetical trials through this model.

We assume that we ran 100 hypothetical trials of monthly returns for the our stock or asset. Among them, two outcomes were between -15% and -20%; and three were between -20% and 25%.

That means the worst five outcomes (that is, the worst 5%) were less than -15%. The Monte Carlo simulation, therefore, leads to the following VAR-type conclusion:

- with 95% confidence,
- we do not expect to lose more than 15% during any given month!


We are.

We are.

An experienced team of Energy and IT experts operate under E-ntelligence ltd umbrella since 2013.

<u>The founder & Owner:</u>

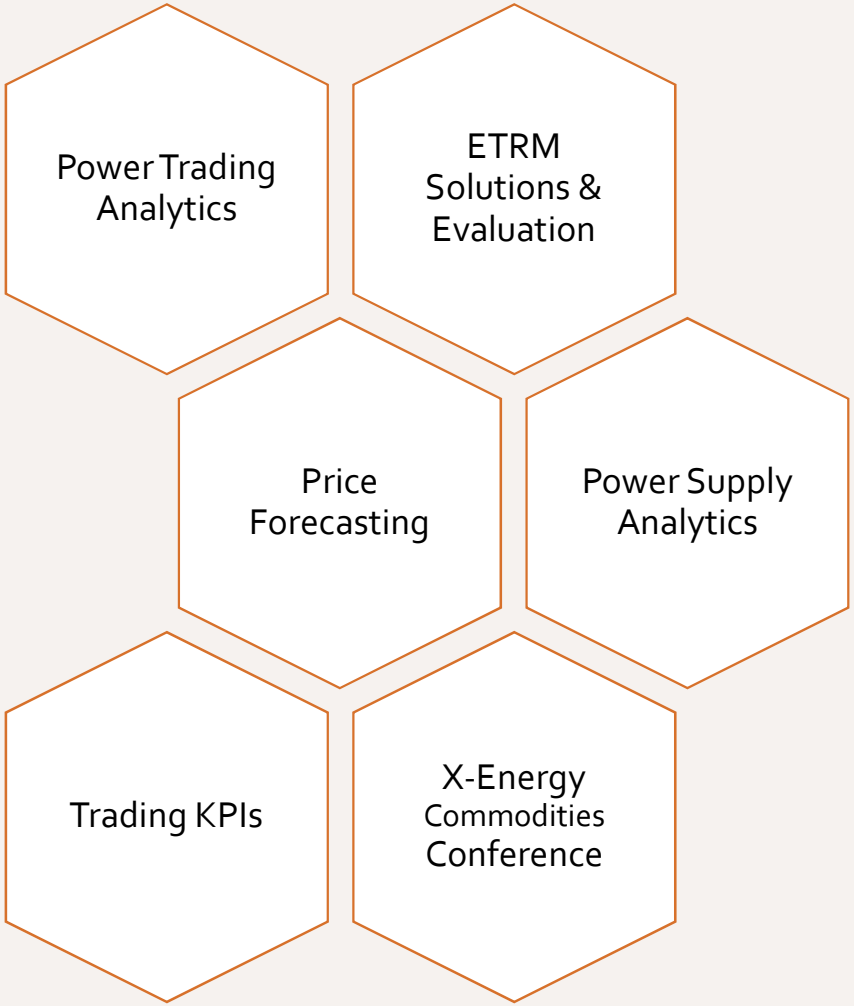
- ***Ioannis Psarros**, Power Trader since 2008*

Linkedin profile:

https://www.linkedin.com/in/ioannis-psarros-85017712?lipi=urn%3Ali%3Apage%3Ad_flagship3_profile_view_base_contact_details%3BK7uO%2FQ7uTeG2TrMP5ScAOA%3D%3D


We do.

We do.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UNIVERSITY OF PIRAEUS

Department of International & European Studies

MSc in Energy: Strategy, Law and Economics

Thank you!

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Our Knowledge. Your Value.

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