

INTRODUCTION TO COMMODITY MARKETS AND COMMODITY DERIVATIVES

Finance and Risk Engineering

Instructor: Roza Galeeva
Email: rg63@bu.edu

Course description

Energy markets and energy derivatives are unique and require special attention and special risk management tools.

1. Energy prices are significantly more volatile than benchmarks in other markets, equities, rates and currencies
2. For variety of reasons fluctuations for supply and demand for many commodities can change rapidly on daily or even hourly basis
3. It costs real money to move commodities through time or locations. Commodities at delivery at a particular time and location can exhibit dramatically different dynamics
4. Moreover, while the physical delivery of energy occurs at vast array of delivery locations making price exposure extremely high dimensional, liquidity is concentrated at a small number of benchmarks.
5. Due to physical nature, there are specific phenomena as Samuelson effect, behavior of correlations

Purpose of the course

The purpose of this course is to introduce students to Energy Markets. We will start with a macro perspective, covering main markets and main structures. We will perform a statistical study of the mentioned "stylized" facts about commodities prices and the dynamics, calibration of the models and pricing of the typical financial instruments. The emphasis of the course will be on the practical experience of building the pricing and hedging models specifically for Energy Derivatives, as much as it can be done during 7 lectures. There will be many exercises, involving data analysis, analytics, evaluation of derivatives and simulation. The work will involve Excel and programming in Python (or any other language).

Class Schedule and Location

Thursdays , 9 - 11.30 am online. I plan to hold office hours, so that I could catch up with a small group of students (1-2) individually each week.

Target Audience

This course is intended for students of the Master Program in Science in Financial Engineering, who wants to get a knowledge in commodities markets and learn main technique of valuation and risk for commodity derivatives. It will prepare the students to apply for quantitative positions in commodities shops and broaden their horizon.

Prerequisites

The minimum course pre-requisites is FRE 6083. Some knowledge of stochastic calculus is desirable. Knowledge of a programming language is required for numerical applications.

Agenda

1. Overview of important fundamental and econometric attributes of the core markets: crude oil and refined products, natural gas and electricity. Working with commodities data.
2. Basic evaluation: Commonly traded instruments in energy markets: forwards, swaps, spreads. Forward yields, forward curve structure, carry formalism; Using rolling contracts. Risk neutral evaluation. BS evaluation with time dependent volatility.
3. Forward dynamics, term structure of volatility and correlations. Samuelson effect, behavior of correlations. Evaluation of swaption and Greeks.
4. The most common type of commodities derivatives: spread options. Applications of spread options and their evaluation. Change of numeraire technique Spread option evaluation by different methods: analytical approximations
5. Volatility smiles parameterizations for commodities. "Cleaning" quotes from arbitrage Calculation of implied volatilities using option quotes based on Black and Bacheleir Calibration of skew parameters.

Grading

There will be about five home assignments and a final project, involving analytics, numerics , data analysis and backtesting.

- Individual Home assignments (40%)
- A Project 55%
- Class contributions (5%)

If you have to miss a class, you should inform me or TA in advance by email.