

Project Report

Week 1(12/5/23 - 19/5/23): Learned the basics of Commodity derivatives and risk management from the NPTEL course.

Topics covered from lectures 1-15.

1. Introduction
2. Futures Contracts Specifications
3. Mark - to - Market Margin
4. Commodity Options and Commodity Spreads
5. Pricing and Valuation of Futures Contract
6. Convenience Field, Contango and Backwardation
7. Commodity Basic Risk
8. Minimum Variance Hedge Ratio
9. Commodity Indexes

Week 2 (20/5/23 - 26/5/23): Revised the week 1 concept and read research papers.

S. No	Research Paper	What it talks about	Modelling Used	Links
1	Fundamentals of Futures and Options	<ol style="list-style-type: none">1. Futures Contracts2. Option Contracts3. Put-Call Parity4. Option Pricing5.		Link
2	CME Group Volatility Index (CVOLtm) Benchmark Methodology	<ol style="list-style-type: none">1. CME Group Volatility Index (CVOL) Methodology for Single Product,		Link

		<p>Single Expiration</p> <p>2. Broad-Based Index Construction (Vega)</p> <p>3. Derivative Indicators</p> <p>4. Short-Term Interest Rate (STIR) Methodology</p> <p>5. Yield-Volatility Methodology</p>		
3	GARCH101	<p>1. ARCH/GARCH Models</p> <p>2. A Value at Risk</p> <p>3. Extensions and Modifications of GARCH</p>		Link
4	Volatility Models	<ul style="list-style-type: none"> • Characteristics of volatility • Structure of a model • ARCH Model • GARCH Model • Extensions to the GARCH framework • The stochastic volatility model • Multivariate GARCH models 		Link
5	Conditional price volatility,	1. Granger casualty test	1. GARCH condition	Link

	speculation, and excessive speculation in commodity markets: sheep or shepherd behaviour?	<ol style="list-style-type: none"> 2. Nonlinear Granger causality: Diks and Panchenko test 3. Volatility measures 4. Speculative measures 5. Non-speculative measures 	<ol style="list-style-type: none"> al volatility 2. Granger analysis 	
6	Relation between Open Interest and Volatility in Commodity Markets	<p>A two-stage the authors employed the following methodology:</p> <ol style="list-style-type: none"> 1. The authors investigate the relationship between open interest and volatility. 2. The authors employ the E-GARCH model and consider the asymmetric response of volatility to shocks of different signs. <p>Finally, the authors believe in a regression framework to scrutinise the contemporary</p>	<ol style="list-style-type: none"> 1. EGARCH Model 	Link

		relationships between open interest and futures prices (volatility).		
7	Volatility and Commodity Price Dynamics	<ol style="list-style-type: none"> 1. Model of Price, Inventory and Volatility 2. Euler equation 3. Empirical Specification 4. Data and estimation 5. GMM (Generalized method of moments) estimation 		Link

Week 3 (27/5/23 - 2/6/23): Focused on three topics:

Read Research papers on the relationship between volume, open interest and volatility.

S.No	Research Paper	What it talks about	Modelling Used	Link
1	Relation between Open Interest and Volatility in	<p>A two-stage the authors employed the following methodology:</p> <ol style="list-style-type: none"> 3. the authors 	2. EGARCH Model	Link

	Commodity Markets	<p>investigate the relationship between open interest and volatility.</p> <p>4. the authors employ the E-GARCH model and consider the asymmetric response of volatility to shocks of different signs.</p> <p>Finally, the authors consider a regression framework to scrutinise the contemporaneous relationships between open interest and futures prices (volatility).</p>		
2	Analysis of Volatility Volume and Open Interest for the Nifty Index Futures Using GARCH Analysis and VAR Model	<p>GARCH is used to estimate volatility for Nifty Index futures on day trades. To determine if a contemporaneous or causal relation exists between volatility volume and open interest for Nifty Index futures traded on the NSE.</p>	<ul style="list-style-type: none"> • GARCH (1,1) Model • VAR Model 	Link

		<p>according to this study, empirical analysis establishes that volume has a stronger impact on volatility than open interest. The impulse originating from the volatility of volume and open interest is low.</p> <p>Sections:</p> <ul style="list-style-type: none"> • Literature review • Data description • GARCH (1,1) Model • VAR Model • Variance Decomposition • Impulse Response • Empirical Findings 		
3	<p>Volatility, open interest, volume, and arbitrage: evidence from the S&P 500 futures market</p>	<p>The VAR model is used to study the dynamic interactions and causal relationships among volatility, open interest, trading volume and arbitrage opportunities. As market volatility increases, investors sell their equity and futures positions with relatively larger price</p>	<ul style="list-style-type: none"> • VAR Model 	Link

		<p>drops. Pricing error is critical in linking implied volatility and the level of open Interest.</p> <p>Section:</p> <ul style="list-style-type: none"> • VAR Model • Data and variable measurement • Empirical results 		
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Some of the research papers which is to study:

- ❖ **Dynamics between trading volume, volatility and open interest in agricultural futures markets: A Bayesian time-varying coefficient approach [\(Link\)](#)**
- ❖ **An empirical examination of the relationship between future spreads, volatility, volume, and open interest [\(Link\)](#)**
- ❖ **Options and earnings announcements: an empirical study of volatility, trading volume, open interest and liquidity [\(Link\)](#)**
- ❖ **Rational Theory of Warrant Pricing [\(Link\)](#)**
- ❖ **Stock Volatility and the Levels of the Basis and Open Interest in Futures Contracts [\(Link\)](#)**

Studied the topics of Time Series [\(Notes\)](#)

- Autocorrelation and Partial correlation
- Stationarity
- Unit roots
- Augmented Dickey-Fuller Test
- White Noise
- Lag Operator
- Autoregressive model
- Moving Average Model
- Moving Average and ACF
- Invertibility of time series
- ARMA Model
- ARIMA Model
- Seasonality
- Seasonal ARIMA Model (SARIMA Model)
- ARCH Model
- GARCH Model
- VAR Model
- Granger Causality

Studied various volatility models: A research paper compiling the modelling of various types of volatility models (univariate and stochastic models) [\(Link\)](#)

- Characteristics of volatility
- Structure of a model
- ARCH Model
- GARCH Model
- Extensions to the GARCH framework
- The stochastic volatility model
- Multivariate GARCH models

Week 4 (3/6/2 - 9/6/23): Read news and articles related to the global commodity market for the research questions. Some of the news articles and research papers read this week are:

S. No.	Research Paper	What is discussed?	Link
1	Commodity markets: shocks and spillovers	<p>Replacing Russian oil output in global markets would be difficult, given the limited spare capacity and subdued investment in new projects</p> <ul style="list-style-type: none"> • Persistently high oil prices may add upward pressure to the price of grains and oilseeds by boosting their use in the production of biofuels, such as ethanol and biodiesel. • The recent outsize shock to natural gas prices could have a large and protracted impact on electricity prices for final users would be a major headwind to industrial production. <ol style="list-style-type: none"> 1. An uneven shock to commodity prices 2. Oil markets: cascading down to agricultural markets? 3. Finding new oil sources 4. Oil and agricultural prices: linked by biofuels 	Link

		5. Natural gas markets: the electricity connection	
2	Commodity prices surge due to the war in Ukraine	<p>The war has disrupted production and trade of several commodities, particularly those where Russia and Ukraine are key exporters, including energy, fertilizers, and grains. These price increases come on top of already tight commodity markets due to a solid demand recovery from the pandemic and numerous pandemic-related supply constraints.</p> <ol style="list-style-type: none"> 1. The potential impact of the war in Ukraine on commodity markets happens in two ways: the physical impact of blockades and the destruction of productive capacity; and the impact on trade and production following sanctions. 2. The European Union (EU) and some Emerging Markets and Developing Economies (EMDEs) may be severely affected by trade disruptions. 3. The war in Ukraine has caused significant disruption to Russia's energy exports. 4. The fertilizer market is subjected to supply disruptions. 5. Russia and Ukraine have in 	

		recent years accounted for about one-quarter of global exports of wheat.	
3	The Russia-Ukraine War and Changes in Ukraine Corn and Wheat Supply: Impacts on Global Agricultural Markets	<p>Ukraine's corn and wheat production and exports are of broad interest because they comprise a significant share of the globe. Still, those kept. Overall, corn and wheat exports from Ukraine in the 2021/22 marketing year were down 20% from projections made before the conflict. For 2022/23, large declines in exports of approximately one-half to two-thirds were initially anticipated. Still, those initial worst fears about lost or stranded Ukrainian agricultural supplies have not been realized. After spiking in the months following the start of the war, commodity prices have moderated to pre-war levels which remain high in historical terms. Going forward, corn and wheat markets will balance supply response to high prices occurring in other major production regions with the prospects for continued war-induced supply losses in Ukraine.</p> <ol style="list-style-type: none"> 1. Changes in Expectations for Ukraine Corn and Wheat Production 2. Changes in Expectations for Ukraine Corn and Wheat Exports and Ending Stocks 	Link

		3. Impacts on Global Commodity Markets	
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Some research ideas are:

- 1. Shocks and spillover effect due to Russia-Ukraine War on wheat, sunflower, fertilisers, and energy.**
- 2. Copper Market Speculation and Price Volatility: Explore the impact of speculation and financialisation on copper price volatility.**
Investigate the role of financial investors, such as hedge and commodity index funds, in influencing copper prices and examine the potential implications for market stability and risk management.
- 3. Brexit and EU-UK Trade Relations:** The Brexit process and the subsequent trade relations between the European Union (EU) and the United Kingdom (UK) have notably affected global commodity markets. Here are some key impacts:
 - **Agricultural Products:** The EU and the UK have historically had significant trade in agricultural products. With Brexit, new trade barriers and customs requirements were implemented, affecting the flow of agricultural goods between the two entities. This led to disruptions in supply chains, increased administrative burdens, and changes in

pricing dynamics for agricultural commodities such as meat, dairy products, and fruits and vegetables.

- **Fisheries:** Fisheries were a contentious issue during the Brexit negotiations. The UK's departure from the EU's Common Fisheries Policy meant changes in fishing rights and access to fishing grounds. The new arrangements impacted the fishing industry and resulted in changes in seafood trade patterns, affecting global seafood commodity markets.
- **Energy:** The energy sector, particularly natural gas and electricity, was affected by Brexit. The UK and the EU are interconnected regarding energy infrastructure and trade. The new trade relations resulted in changes to energy market regulations, cross-border energy flows, and price dynamics, impacting global energy commodity markets.
- **Metals and Mining:** The UK is a significant player in the metals and mining industry, and its trade relations with the EU have implications for global commodity markets. Changes in customs arrangements and regulations impacted the flow of metals and minerals between the UK and the EU, affecting supply chains and potentially influencing prices of commodities such as steel, aluminium, and copper.
- **Financial Markets:** Although not directly related to physical commodities, Brexit significantly impacted financial markets. The UK's departure from the EU led to regulation changes and access to financial services. These changes affected commodity derivative markets, commodity trading,

and hedging activities, impacting the functioning of global commodity markets.

The effects of Brexit and the EU-UK trade relations on global commodity markets are diverse and interconnected. The disruptions caused by changes in trade rules, regulations, and market access have affected various sectors, including agriculture, fisheries, energy, metals, and financial markets. The full extent of these effects may continue to evolve as new trade arrangements, and relationships are established between the EU and the UK.

4. **India-China Border Dispute:** The trade tensions between India and China have notably affected commodity markets. Here are some key impacts:

1. **Raw Materials and Metals:** India and China are major consumers of various raw materials and metals, including iron ore, steel, copper, and aluminium. The trade war disrupted these markets as both countries implemented trade barriers and import restrictions. For instance, India increased tariffs on Chinese steel and aluminum products, leading to a decline in imports and impacting prices in the global market.
2. **Agricultural Products:** India is a significant exporter of agricultural products, such as rice, sugar, and cotton, while China is a major importer. The trade war resulted in reduced Indian agricultural exports to China due to increased trade barriers and import restrictions. This hurt Indian farmers and the agricultural commodity markets.

3. **Chemicals and Pharmaceuticals:** China is a major supplier of chemicals and active pharmaceutical ingredients (APIs) to India. The trade tensions led to disruptions in the supply chain, affecting the availability and prices of various chemicals and pharmaceutical products. India has implemented policies to reduce its dependency on Chinese imports in these sectors.
4. **Consumer Goods:** The trade war between India and China also impacted the consumer goods market. India imposed restrictions on imports of various Chinese consumer goods, including electronics and appliances, which affected the availability and pricing of these products in the Indian market.
5. **Textiles and Apparel:** India is a significant exporter of textiles and apparel to China. The trade tensions reduced demand for Indian textile products in China, leading to lower exports and impacting India's textile and apparel markets.
6. These effects on commodity markets highlight the interdependence of India and China in various sectors. The trade war between the two countries created market uncertainties, supply chain disruptions, and altered trade patterns, impacting producers and consumers. However, it's important to note that the effects can vary depending on the specific commodities, trade policies, and market dynamics in each sector.

Environmental Trade Restrictions which affected the global commodity market

Some notable environmental trade restrictions that have had impacts on the global commodity market:

- **Timber and Wood Products: The European Union Timber Regulation (EUTR)** restricts the import of illegally harvested timber and wood products into the EU. It requires companies to exercise due diligence in ensuring the legality of the timber they trade. This regulation has had implications for the global timber market, particularly in countries exporting timber to the EU.
- **Illegal Wildlife Trade:** Various countries and international agreements have implemented trade restrictions on endangered species and their products to combat illegal wildlife trade. These restrictions aim to protect biodiversity and conserve endangered species. They impact commodities such as ivory, rhino horn, tiger products, and exotic animal skins.
- **Ozone-Depleting Substances: The Montreal Protocol** on Substances that Deplete the Ozone Layer restricts the trade of ozone-depleting substances (ODS), including chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). These restrictions have led to the phase-out of these substances globally, affecting industries such as refrigeration, air conditioning, and aerosols.
- **Endangered Species Protection: The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** regulates the trade of endangered species and their parts. **CITES places restrictions on the import and export of species listed under its appendices**, impacting commodities such as certain plants, reptile skins, and exotic animal species.

- **Conflict Minerals:** Regulations, such as the **U.S. Dodd-Frank Act and the EU Conflict Minerals Regulation**, aim to address the trade of conflict minerals, including tin, tantalum, tungsten, and gold, which are associated with human rights abuses and armed conflicts in certain regions. These restrictions require companies to undertake due diligence and report on the sourcing of these minerals.
- **Hazardous Chemicals and Waste:** International agreements, such as the **Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal**, regulate the trade of hazardous chemicals and waste. These restrictions aim to prevent the movement of hazardous materials to countries lacking the capacity to manage them safely.
- These environmental trade restrictions are designed to promote sustainability, protect endangered species, conserve natural resources, and reduce environmental harm. While they have had impacts on specific commodity markets, their overall effectiveness and enforcement can vary across countries and regions.