Structural Analysis of Oil Price Shocks

Quantitative Modeling & Risk Management Application

Bachelor's Thesis Project – Industrial Engineering

Executive Overview

This project develops a quantitatively grounded and structurally interpretable framework to analyze oil price dynamics and translate them into scenario-based risk and hedging applications for energy-exposed firms.

Using a sign-restricted Structural VAR model, the framework disentangles supply, demand, and precautionary oil-market shocks and propagates them into price paths, tail-risk metrics, and stress scenarios designed to support market analysis, scenario planning, and risk-management decisions.

Problem

Crude oil prices are driven by heterogeneous structural shocks—such as supply disruptions, aggregate demand fluctuations, and precautionary demand pressures—which generate fundamentally different market and cost-risk profiles.

Treating oil price movements as homogeneous shocks leads to misleading inference, distorted scenario analysis, and weak risk assessment, particularly for fuel- and energy-intensive industries.

What I Built

- Constructed a monthly macro–energy dataset (1990–2024) integrating oil prices, production, global activity indicators, and inventories.
- Developed a structurally identified econometric framework to disentangle oil-market shocks with clear economic interpretation.
- Designed scenario-based stress-testing tools to assess fuel-cost exposure and hedging implications under different shock compositions.

Methods & Tools

- Vector Autoregressions (VAR) and Structural VARs (SVAR) with sign restrictions
- Time-series diagnostics, impulse-response analysis, and distributional assessment
- Python, MATLAB, Git (fully reproducible and modular research workflow)

Why It Matters

By separating the economic sources of oil price risk, this project bridges quantitative market modeling and applied risk management.

The framework enables scenario-based analysis of fuel-cost exposure, cost-at-risk metrics, and market-driven hedging decisions, supporting more informed planning and risk mitigation for energy-intensive firms operating under price uncertainty.

Note. This document provides a concise, non-technical overview of the project. The complete academic thesis—including full methodology, results, and the entire codebase—was developed and defended as my Bachelor's dissertation in Industrial Engineering and is available in the linked GitHub repository.