Interim Report: Brent Oil Analysis & Change Point Methodology

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1. Business Objective

Birhan Energies aims to quantify the impact of geopolitical shocks (sanctions, conflicts, OPEC policies) on Brent Crude price stability. By distinguishing transient noise from structural regime shifts using statistical change point detection, we provide clients—sovereign funds and policymakers—with actionable triggers for risk hedging and strategic planning.

2. Task 1: Methodology & Initial Findings

2.1 Analytical Workflow

We executed a rigorous pipeline: (1) **Ingestion:** Cleaned 10 years of Brent price data (2012-2022); (2) **Transformation:** Converted prices to stationary Log Returns to stabilize variance; (3) **Enrichment:** Integrated a dataset of 15 geopolitical events as ground truth for validation.

2.2 Event Dataset (Sample of 15)

Date	Event
2011-02-17	Libyan Civil War Begins
2014-06-01	ISIS Captures Iraqi Oil Fields
2014-11-27	OPEC Maintains Production
2016-06-23	Brexit Referendum
2016-11-30	OPEC Production Cut Agreement
2018-05-08	US Withdraws from Iran Nuclear Deal
2018-11-01	US Grants Iran Sanctions Waivers
2019-05-02	US Ends Iran Sanctions Waivers
2020-03-06	Saudi-Russia Oil Price War
2020-03-11	COVID-19 Pandemic Declaration
2020-04-12	OPEC+ Historic Production Cut
2021-02-01	Texas Winter Storm
2022-02-24	Russia Invades Ukraine
2022-03-31	IEA Emergency Oil Release
2022-10-05	OPEC+ Production Cut (2M bpd)

2.3 Exploratory Data Analysis (EDA)

Initial analysis confirms structural complexity. Raw prices are **non-stationary** (ADF p=0.199), exhibiting distinct regimes (Fig 1). Log Returns are stationary (p<0.001) but show extreme **Volatility Clustering** (Fig 2) and high Kurtosis (>100), confirming "fat-tail" risks typical of energy markets.

Fig 1: Brent Crude Prices (2012-2022).

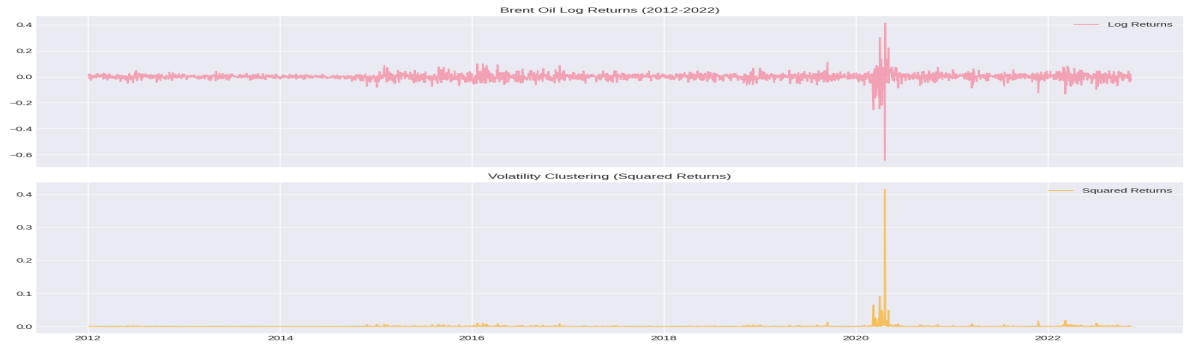

Fig 2: Volatility Clustering in Returns.

2.4 Critical Assumptions & Limitations

Critical Distinction: While our models detect statistical associations between events and price breaks, **correlation does not imply causation.** A change point near a sanctions date suggests a relationship, but cannot isolate it from confounding factors (e.g., global demand shifts, USD value). We assume market efficiency is imperfect, allowing for lags. Furthermore, we assume Brent is a valid proxy for global oil sentiment.

3. Strategic Roadmap (Tasks 2 & 3)

Task 2: Bayesian Modeling (In Progress): We are deploying a PyMC model to estimate probability distributions for change points ($ au$). Rather than a single date, this approach quantifies the *uncertainty* of when a regime shift occurred (see Fig 3 prototype).
Task 3: Dashboard Delivery: The final product will be a React/Flask dashboard allowing stakeholders to interactively visualize these risk regimes against event timelines.

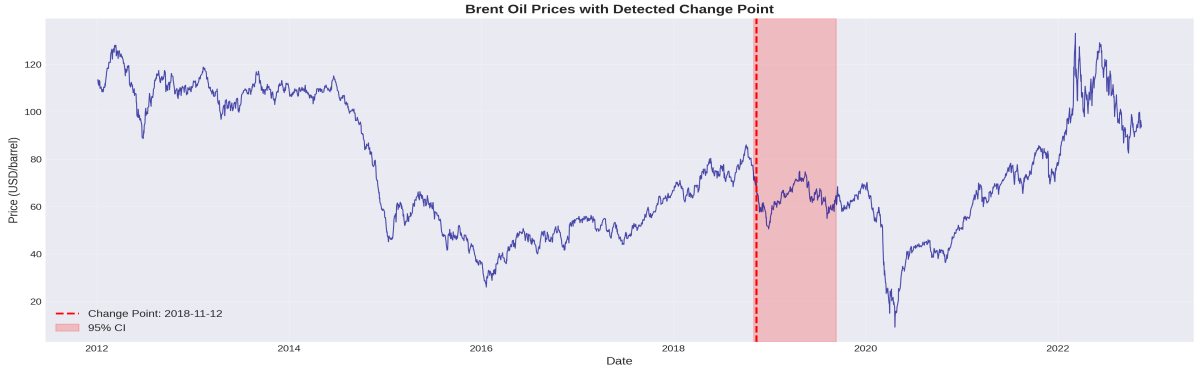

Fig 3: [Prototype] Expected Bayesian Change Point Output.