UK SAP Supply and Demand Trading

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AlgoGators Investment Proposal

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1 Main Idea

This strategy aims to exploit weather forecast revisions, demand changes, storage, and natural gas inflows in relation to the UK System Average Price (SAP) for natural gas trading. The System Average Price is a contract traded on the On-the-Day Commodity Market (OCM) in the United Kingdom that is closely tied to the UK NBP futures contracts as a representation for the underlying product. By forecasting SAP returns based on alternative natural gas data sets, we believe that there are trading opportunities that can be found while the market adjusts during the next day. The proposed edge of this strategy is forecasting dynamics before pricing has changed for SAP and taking a long or short position to exploit it before it is priced in.

Our strategy is a statistical arbitrage approach that aims to exploit brief inefficiencies between fundamental factors impacting natural gas trading and price levels. We believe that this strategy diversifies the fund's strategy capabilities and provides strong returns in preliminary testing. The reliance on alternative data for this strategy differs from the existing strategies implemented by the fund and exposes the available capital to the European energy market.

2 Economic Thesis

This strategy is based on market inefficiencies and capturing pricing dynamics before other players in the space of UK natural gas trading. We have drawn our main idea from a paper "Mathematical Models for Natural Gas Forecasting" by Vitullo et al. in which multiple mathematical models and features are analyzed for US gas trading. We drew from the paper that demand forecasting for natural gas is feasible using specific pieces of alternative data. From this we found that, as with all markets, SAP trading in the United Kingdom follows supply and demand trading. Our economic thesis is that if we can use demand and supply forecasting as part of our model, we can accurately model the underlying returns of SAP for the next day.

Specifically, the United Kingdom was chosen as it gets its natural gas from two main storage pathways, from the North Sea production and pipe network and the import pathways from Norway, the Netherlands, and Belgium. In addition, there are liquefied natural gas deliveries made by tanker ships that deposit into the various storage sites across the United Kingdom. These natural gas deposits are completed cyclically. Typically, injected into storage sites during lower periods of demand during the summer and withdrawn closer to winter. The Rough storage site contains most of the UK's natural gas storage. Modeling the gas flow rate into this facility provides a comprehensive understanding of UK demand markets for natural gas.

Therefore, the economic thesis this strategy is based on is that there is a seasonality around demand and supply in British natural gas influenced by weather data, line pack, and inflows within the network that created cycles that this strategy can take advantage of.

3 Implementation

During the modeling stage of the strategy, we initially used multi linear regression (MLR) because of its reliability and explainability. However, we found that the MLR model struggled significantly at predicting changes in the SAP that were close to zero. No matter what additional features or tweaking was done, MLR consistently failed at this task and was a clear sign of a needed improvement. This is where the multi-layer perceptron (MLP) came in. In fact, the MLP had the opposite characteristic, it was accurate at predicting changes close to zero but was terrible at extrapolating for extreme features (such as unforeseen temperatures). These models perfectly complimented each other.

With that said, this team leverages a combination of each model's signal to increase the strategies r^2 and create a more robust system. After the modeling method was selected, we sourced OHLCV data from 2020 to present-day from www.data.nationalgas.com. Features such as actual/forecasted temperatures, linepack (quantity of natural gas inside pipelines) and seasonal demand. Thereafter, derived features were engineered such as the temperature surprise (the difference between expected and realized temperatures), whether a day is a weekday and a positional encoding through sinusoidal waves. Note: not all loaded data was inserted into the models. Only features that were determined to increase the accuracy of the models were passed into the models for prediction.

A limitation of our implementation was the inability to account for transaction costs and slippage because of the lack of data. Due to the sparsity of the natural gas contracts we sourced from Databento, we compromised direct results in exchange for providing the models sufficient training data. As explained earlier, SAP is an OTC asset which admittedly makes it hard to trade. On the other hand, it has the benefit of accurately tracking the price of natural gas. Therefore, this report proposes that in predicting the value of SAP, we can indirectly predict assets which it derives its value from. Of course, slippage and transaction costs remain a concern nonetheless, though this strategy is successful enough to deem it negligible.

4 Risk Management & Controls

Our strategy performs excellently in highly volatile market conditions, while particularly poorly in low volatility bear markets. We believe that our strategy fundamentally performs better when the market price is difficult to determine for the main financial traders of SAP. As a result, our risk management and control framework accounts for our advantage. We use a regime detection model to implement our position sizing. We use a multiplier between 0.5 to 1.5 based on the current market regime. The percent capital allocated per trade is scaled based on this multiplier to earn more when the probability of return is higher. In this way we aim to reduce the amount we lose with uncertain trade.

The actual position sizing is based on multiplying the regime multiplier by the base position. The base position is assumed to be 10% of allocated capital. Multipliers are used to scale when the algorithm has high profitability and reduce risk when in poor performing regions in the market. The regime detection model helps to reduce drawdown performance on the strategy as it reduces capital spent in potentially unpredictable market conditions. This is one of the main drawdown risk mitigators. We also decided to use a basic ATR position cutting algorithm to stop out poor trades. Although basic, this seems to perform well enough, however, we understand that we should use a more specific risk framework specific to chosen asset being traded. As we are modeling SAP (which has high relevance to NBP futures), we decided that this framework protects against enough drawdown, however, the actual risk performance for this strategy needs more comprehensive research for its implementation with larger test windows.

The implementation has no correlation to existing fund strategies and diversifies the portfolio as it provides exposure to the European energy markets. This strategy heavily draws on alternative data and does not rely on OHLCV data for signals like with other strategies in the fund.

5 Performance

With a sample size of 100 random initializations of the system, this team is 95% confident that the true Sharpe Ratio our strategy is in the interval [2.01, 2.35] (see figure A). We recognize this interval to be incredibly high and, as such, an equally incredible effort was made to remove look-ahead bias within the data and the training set. We encourage the reader to see for themself and verify our findings. The max drawdown is risk adjusted with 17% on average. Calmar ratio, Sortino ratio, and r^2 are 5.23, 4.67, and 0.935 respectively. More performance metrics and charts are available in the appendix. We find that the model has good ability to generalize to unseen data. We find that since the market we have modeled is a OTC product, there are distinct inefficiencies that we are able to model and exploit. We believe that our strategy's results are to be taken with caution and more data must be accessed from nationalgas.com by private inquiry.

6 Appendix

Figure A

95% Confidence Intervals:

	mean	lower_bound	upper_bound
sharpe	2.182673	2.008447	2.356899
sortino	4.673917	4.187106	5.160728
calmar	5.233789	4.648170	5.819408
r2	0.935415	0.916160	0.954669
max_drawdown	-0.174928	-0.181750	-0.168107
final_value	4.575529	3.812774	5.338284

Figure B

Figure C

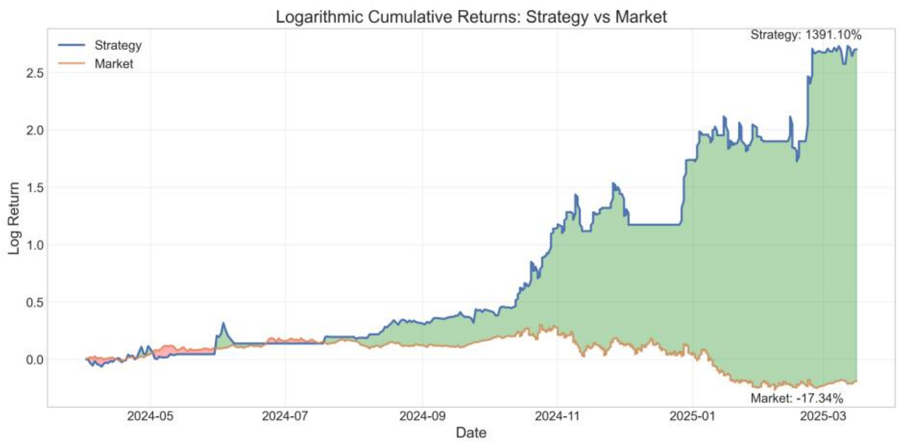
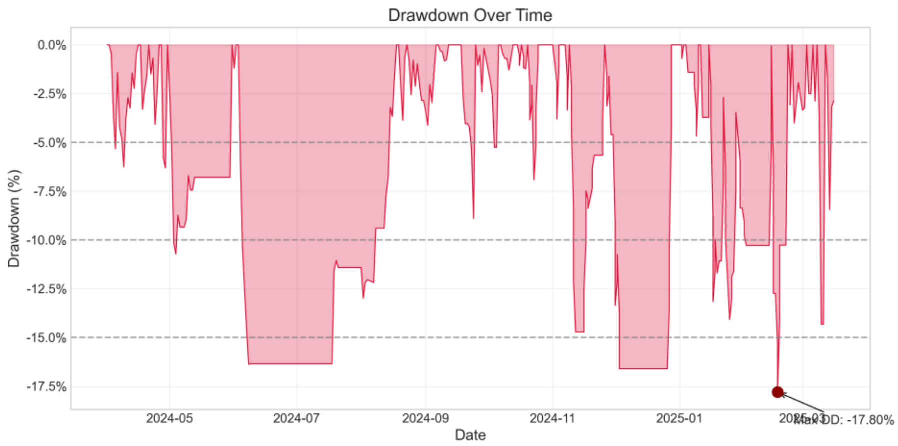


Figure D



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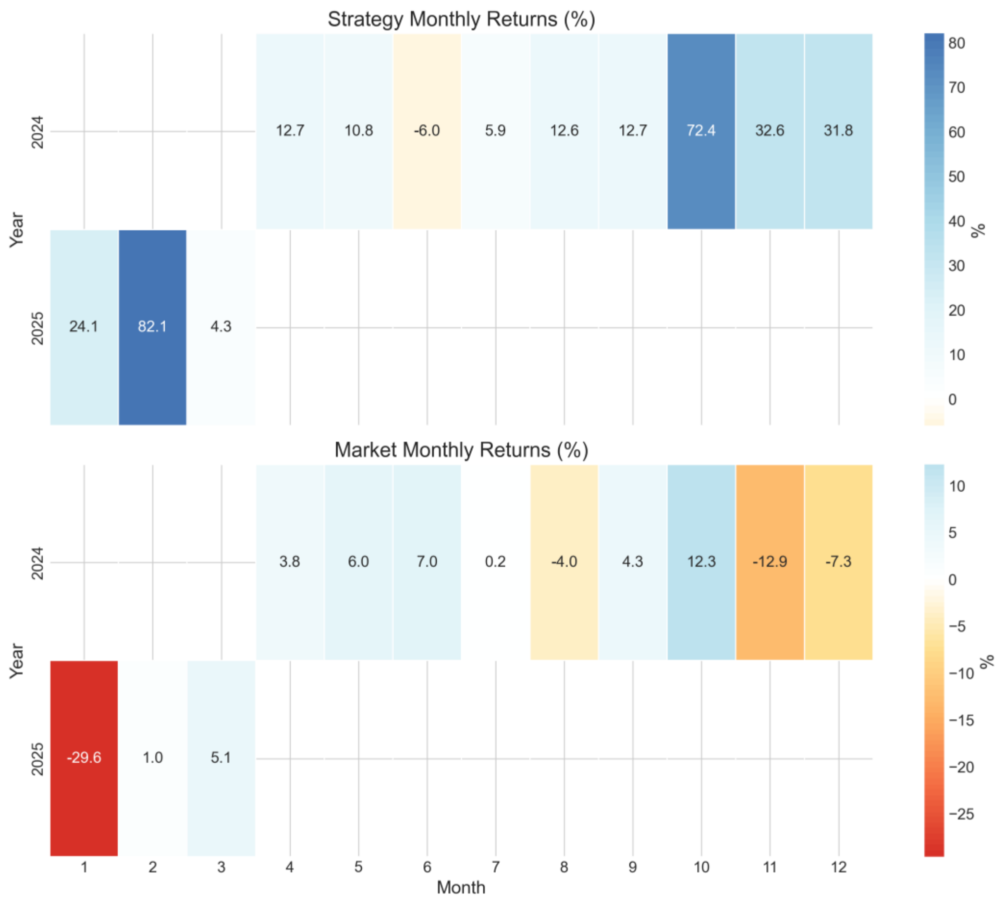

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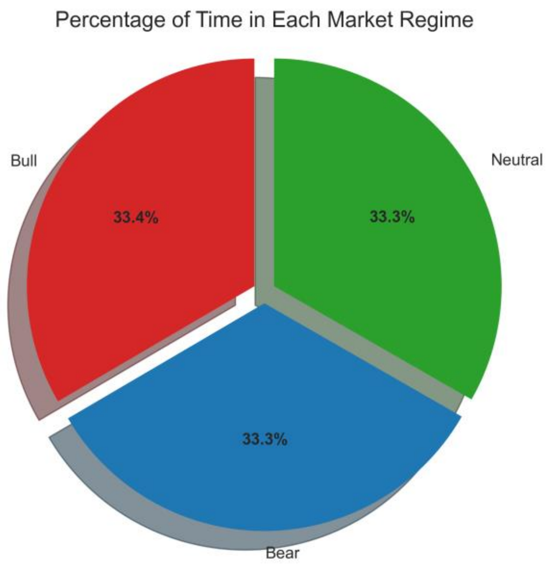


Figure G

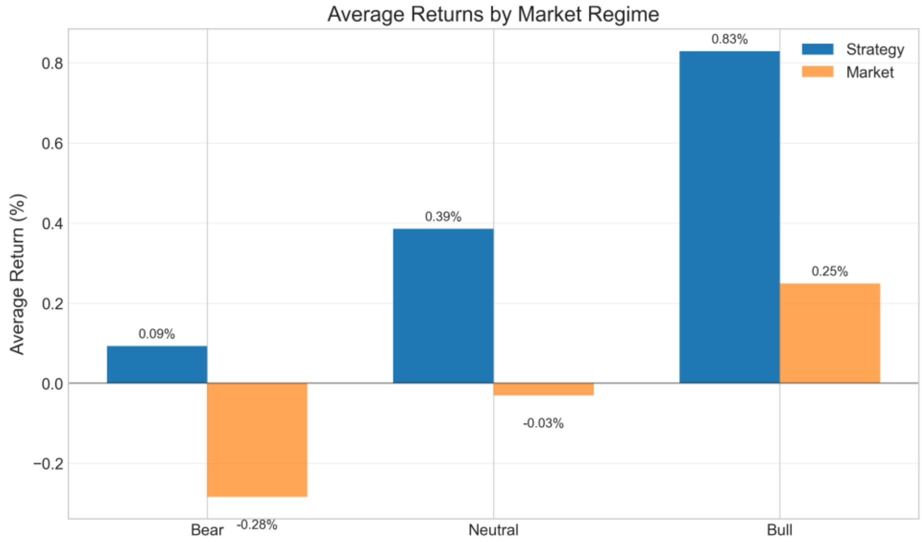
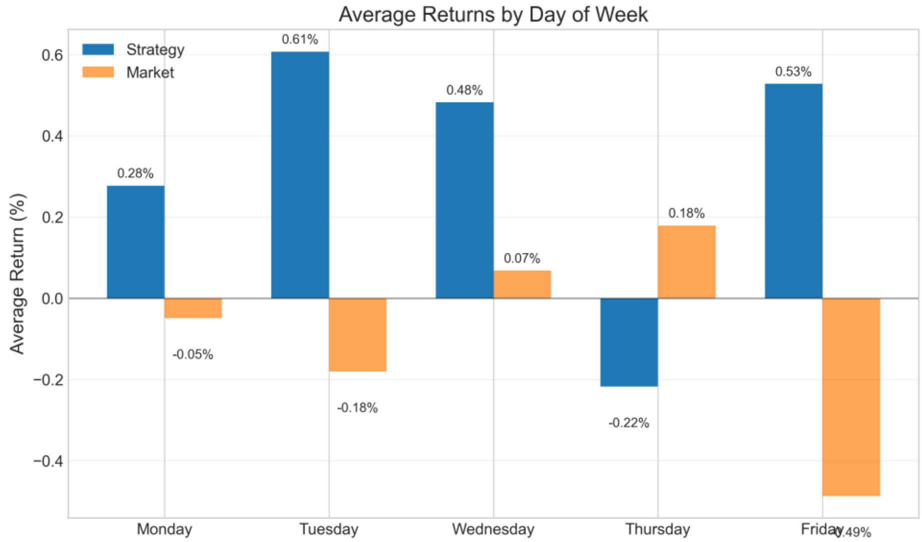
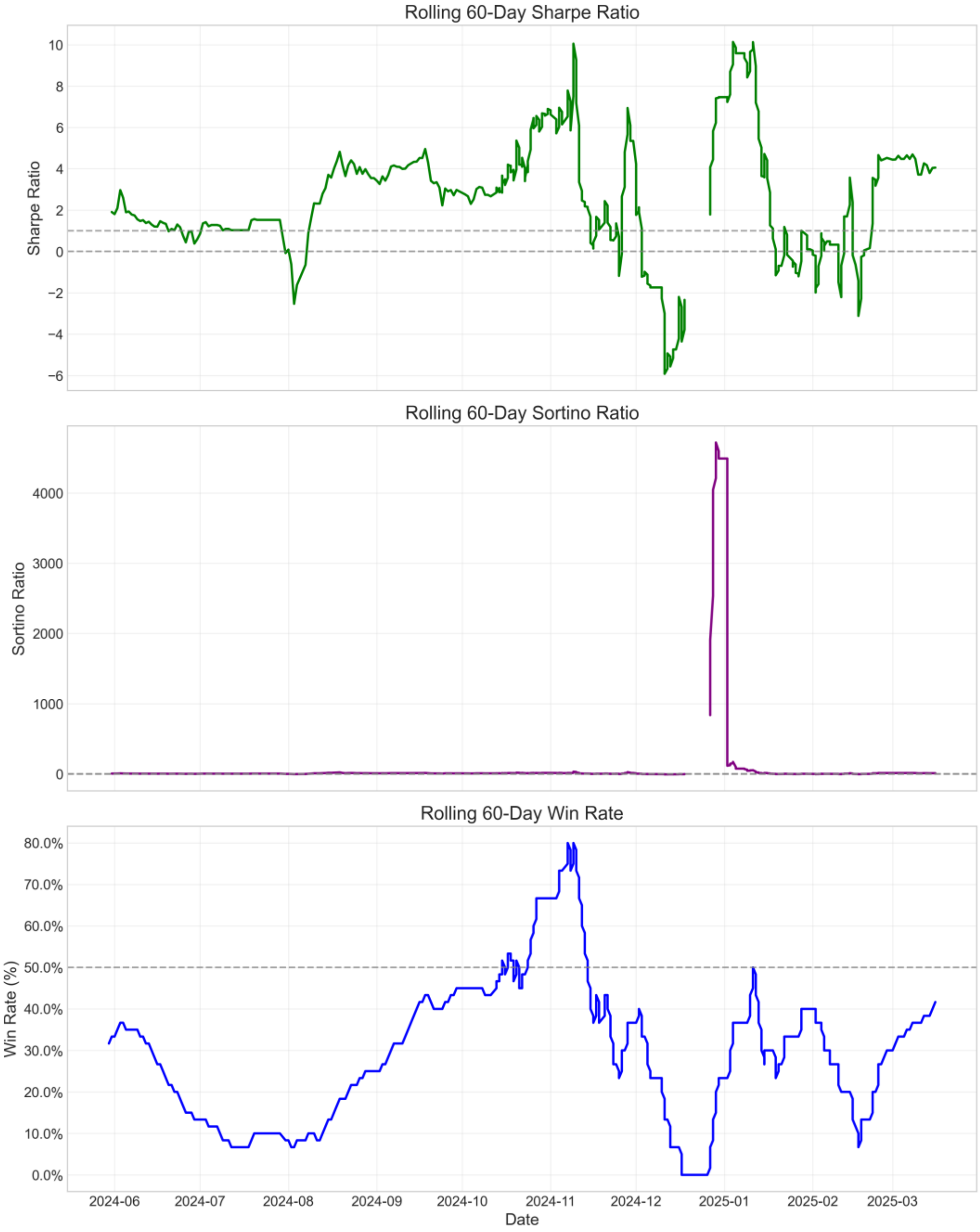


Figure H



Average Returns by Day of Week
Strategy
Market
Average Return (%)
0.6
0.4
0.2
0.0
−0.2
−0.4
0.28%
-0.05%
0.61%
-0.18%
0.48%
0.07%
-0.22%
0.18%
0.53%
-0.49%
Monday
Tuesday
Wednesday
Thursday
Friday

Figure I



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