

# **[OPTIMAL INVESTMENT IN OIL SPARE CAPACITY: A REAL OPTIONS APPROACH]**

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## **Overview**

Few major oil producing countries/ companies hold spare production capacity as a strategic decision. This capacity comes at a price, as the firm has to drill and maintain these idle fields at a cost in order to be ready for production when called upon. The oil industry have always acknowledge the positive role of spare capacity as a buffer in case of an unexpected supply disruption and in reducing excess volatility by calming market sentiment.

However, there has been little discussion about the actual economic value of holding and maintaining this spare capacity. Though some industry analysts have suggested that Saudi Arabia is doing the world a favor, there is evidence to suggest that SA has actually benefited economically from by utilizing this spare capacity.

To examine this question, we employ the a method from pricing real option under uncertainty.

We consider the real option embedded in the decision to hold spare capacity given expected price volatility and the optimal level of spare capacity investment under different technical assumptions related to ramp up rates. Studying the motives of a large oil producer to hold excess idle capacity adds to our understanding of the behavior of large producers within OPEC, and to oil market dynamics and investment cycles in general.

## **Methods**

We examine the firm's decision within a competitive storage model with stochastic demand, where the firm follows the rational policy of investing in spare capacity only if the present value of expected payoffs over the lifetime of the capacity covers all the accumulated maintenance costs over time.

To understand how volatility affects the decision, we analyze the volatility structure of oil forward prices using Principle Component Analysis to examine the correlations between volatilities of different tenors. We show that the PCA method performs better in volatility extrapolation compared to other methods such as GARCH.

The value of oil spare capacity is initially approximated as a series of real options that can be exercised daily, with no technical constraint on the rate at which capacity can be produced. This exercise establishes a theoretical upper bound on the value of spare capacity for given volatilities.

We evaluate spare capacity within a dynamic programming problem, where current decisions by the producing firm affect the state of the system. The dynamic program is solved numerically taking into account the various technical constraints of production out of spare capacity.

Then, to explore the effect of uncertainty on the optimal decision and value function, we allow the forward curve to evolve stochastically.

## **Results**

Analyzing oil's spot and forward price structure confirms some stylized facts like volatility backwardation, where volatilities tend to dissipate at longer tenors.

The value of maintaining spare capacity increases with higher volatility, making investment in spare capacity more likely if short term supply shortages are expected.

As the number of smaller producers enter the market, such as the US shale producer, the market supply curve gets flatter, and the probability of shortages decline. This tends to lower volatility, reducing the value of holding transitional spare capacity in OPEC countries.

## Conclusions

This paper studies the decision to maintain oil production spare capacity by an oil producer. This question is relevant given the recent oil market developments, which saw new small producers, enter the market, leading to a price collapse by more than 60% within one year and ample supply in the market. This development also prompted some traditional producers such as Saudi Arabia to re-examine the value of its costly spare capacity. We model the decision to maintain spare capacity in a single facing a stochastic price forward curve. The results help us better understand the motives of major oil producers (and of OPEC members) with implications on the current oil market environment and volatility.

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