The Convenience Yield and the Informational Content of the Oil Futures Price

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With the expanding use of oil in the global economy over time and its continued high volatility since 1973, individuals with a vested interest increasingly turned to the oil futures market to hedge against future price changes. As a result, the market for oil futures steadily developed, bringing with it increased trading volumes and liquidity. This led policymakers and firms to become more and more reliant on futures prices for their prediction and planning needs. Given such a widespread dependence on the futures market, oil futures would be expected to

contain useful information, notably on the future behaviour of spot prices. Yet, recent research has shown that naive no-change forecasts can often outperform forecasts based on futures prices (see, for instance, Alquist and Kilian (2010) and Chinn and Coibion (2013)), which suggests that futures prices do not hold worthwhile information with regard to forecasting.

In this paper we focus on the extent of information that can be obtained from futures prices when different modeling strategies are used to specify the behaviour of oil futures prices. Our analysis is conducted using a forecast-based perspective. That is, we study the extent to which futures prices are predictable out-of-sample, and in real-time, based on different available models.

The models that we consider for this purpose belong to different branches of the literature on oil price modeling and capture differing stylized facts, however they are all well-known. We examine models based on equilibrium arguments and also models that are purely statistical. Importantly, the former specifications feature a time-varying convenience yield while the latter implicitly assume a constant convenience yield. We show that this distinction plays an important role in determining the extent to which information can be uncovered from futures prices.

In equilibrium-based models for commodities, inventories play an important role; they are held to hedge against unexpected demand shifts. Thus, producers make joint decisions on production

and inventory levels, accounting for the spot price of the commodity and a storage price determined from the so-called marginal convenience yield. The latter is the flow of benefits that accrue to inventory holders from holding a marginal unit of inventory, and, at equilibrium, it is a function of the difference between the spot price and the futures price. We consider the class of models from Schwartz and Smith (2000) and Schwartz (1997) that offer a tractable way to capture such effects. These models allow for an equilibrium relationship between futures prices at different maturities and the spot price, simultaneously also accounting for a time-varying stochastic convenience yield. The models thus imply that prices revert to a long-run equilibrium that may itself randomly change over time. As for our constant convenience yield models, we consider many variants of the popular GARCH specification, including ones that allow for jumps in the mean. Such models have been widely used to capture one of the major features documented in the literature, namely that the volatility of price returns changes over time.

Our empirical analysis is conducted using weekly and monthly crude oil prices and futures of one to four-month maturities. For each data frequency, every model is recursively estimated and one-step-ahead out-of-sample forecasts are calculated. The recursive estimations are conducted over horizons of one, three, and five years, with parameter estimates being updated ahead of every individual forecast. The mean square prediction error criterion is then calculated for each model over the three considered horizons to make the forecasting performance comparisons.

Our results show that models which, at each time period, also take into account the difference between the futures price and the spot price (thereby allowing for a time-varying convenience yield) often produce considerably more precise forecasts, often by margins exceeding 80 per cent. This is notably the case with weekly frequency data, which incidentally is also the frequency at which the EIA publishes information on inventory holdings. In addition, we find that forecast accuracy increases when, in conjunction with the spot rate, a longer date-to-maturity futures is considered. Thus, futures prices do contain economic and financial information that is useful for forecasting, but more importantly, more of this information can be reached when both the price level and the distance of the latter from spot price are jointly considered. By extension, models that rely only on the futures price level (or on the first difference in the level) would be expected to not be particularly successful at outperforming random-walk-based forecasts of spot prices. In this regard, our analysis appears to reconcile to a certain extent some of the seemingly contradictory positions and findings in the literature.