Futures prices are useful predictors of the spot price of crude oil

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Introduction

- Widespread interest in accurately predicting the real price of oil
  (central bank projections, investment decisions, oil-intensive goods purchases)
- Established view: oil futures prices are no more accurate in forecasting spot prices than a simple no-change forecast
  (Alquist & Kilian 2010; Alquist Kilian & Vigfusson 2013)

This paper revisits the established view

1. How should we construct futures curves for the real price of oil?
2. How well did futures prices perform since the financialization of commodity markets?

Bird's-eye view

1. How should we construct futures curves for the real price of oil?
   - Existing literature uses monthly average futures prices
     $\rightarrow$ large(!) accuracy-improvements by using last available futures price observed in the market instead
   - Principle extends to other types of oil-price forecasts
     (Benmoussa et al. 2020, Ellwanger & Snudden 2022a,b)

2. How well did futures prices perform since the financialization of commodity markets?
   - Since 2010 futures are more accurate than no-change forecasts at longer horizons
   - Particularly strong results 3+ years

Typical setup for futures-based forecasts of the real price of crude oil

- Forecaster's goal: predict P^r_{t+h} given month t information
- The real price of oil is the monthly average price

$$P^r_t = \frac{\frac{1}{n}\sum_{i=1}^{n} p_{t,i}}{CPI_t}$$

t = month; i = day of month; n = # of days in month

- Forecast based on h-month-ahead futures price is the monthly average futures price, F^h_t,

$$\widehat{P}^r_{t+h|t} = \frac{F^{t+h}_t}{\widehat{CPI}_{t+h,t}} = \frac{\frac{1}{n}\sum_{i=1}^{n} f^{t+h}_{t,i}}{\widehat{CPI}_{t+h,t}}$$

Is the average futures prices the best forecast?

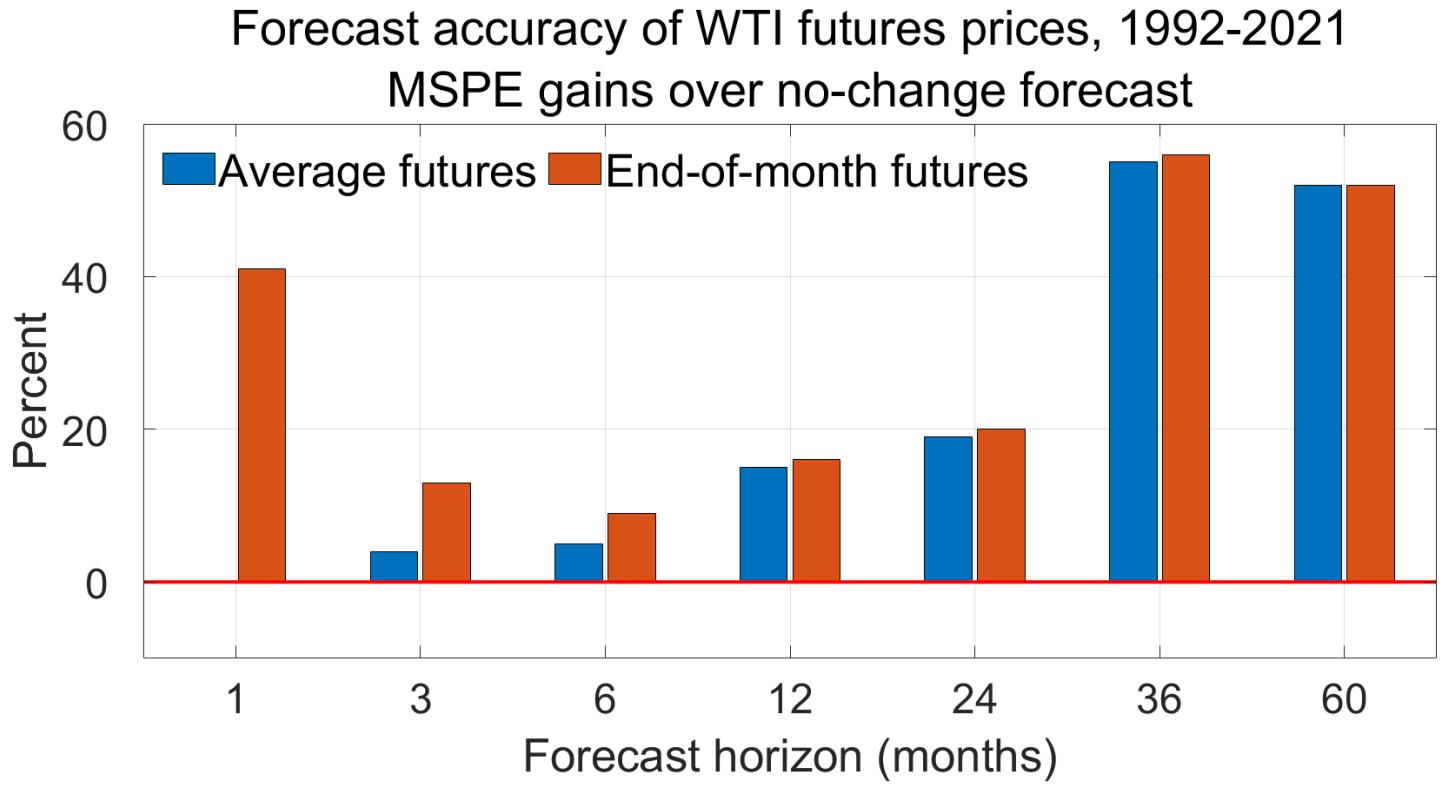
- This paper: let's use last observed (daily) closing price instead of monthly average futures price

$$\widehat{P}^{r}_{t+h|t} = f^{h}_{t,n} / \widehat{CPI}_{t+h,t}$$

where n denotes last day of month t

- Intuition from *Efficient Market Hypothesis*
  - last price contains *all* relevant information
  - averaging dilutes this information with stale prices (Working 1960)
- Real-time application to sample period updated to 2021M1

Futures-based forecasts are now more accurate predictors than the standard no-change forecast



- Short-horizon gains from using end-of-month futures
- Long-horizon gains independent of construction of futures curve

The results hold for a variety of settings

- All major oil benchmarks (WTI, Brent, RAC)
- Construction of futures curves, CPI forecasts
- Similar pattern for directional accuracy of forecasts

- Honorable mention: "adjusted" futures curve
  - using futures with delivery in month $t + h$ to forecast spot prices in month $t + h$ yields some additional gains at short horizons
  - traditional futures curves use futures with delivery in $t + h + 1$ towards the end of the month

Futures-based forecasts - are they really useful?

- Can futures outperform the random walk?
  - The benchmark random walk forecast should be computed from end-of-month spot prices, not the average price P_t^r
    (Benmoussa et al. 2020, Ellwanger & Snudden 2022)

$$\widehat{P}_{t+h}^{r,\text{Random Walk}} = \frac{p_{t,n}}{CPI_t}$$

  - Existing forecasts in the literature perform worse that the random walk at the 1-month-ahead prediction (Ellwanger & Snudden 2022)

- How do they compare to other forecasts?

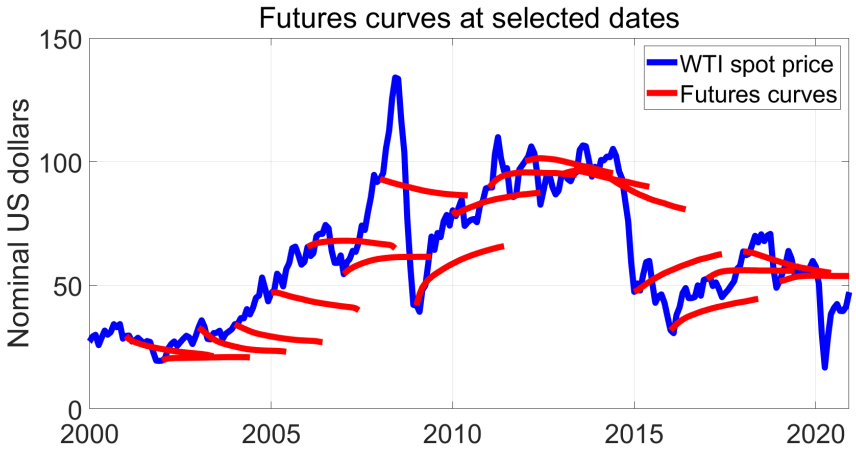
Futures-based forecasts - are they really useful? Yes!

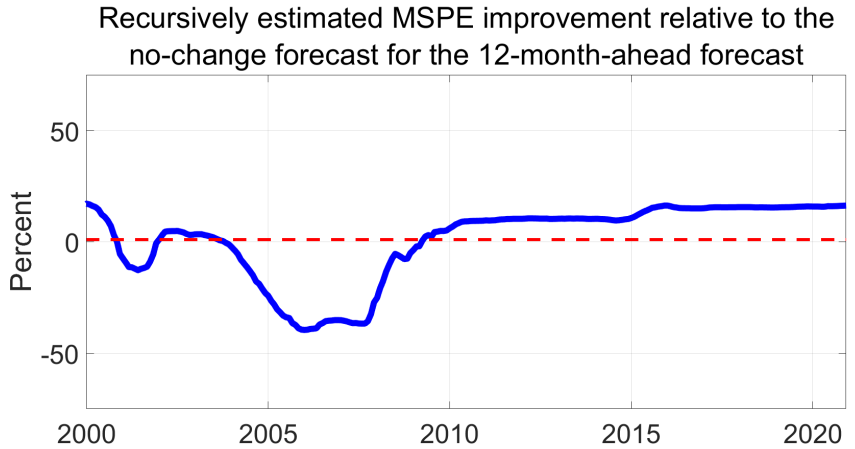
Horizon	1	3	6	9	12	36
Model			MSPE Ratio			
Futures, EoM	**0.58 (0.000)**	**0.85 (0.010)**	**0.90 (0.023)**	**0.88 (0.025)**	**0.83 (0.009)**	**0.45 (0.000)**
EIA	**0.69 (0.003)**	**0.97 (0.310)**	1.06 (0.737)	**0.97 (0.328)**	**0.89 (0.089)**	-
AR	**0.93 (0.223)**	**0.98 (0.420)**	1.01 (0.525)	1.02 (0.564)	1.02 (0.547)	**0.90 (0.348)**
VAR	1.04 (0.612)	1.05 (0.620)	1.15 (0.911)	1.23 (0.971)	1.30 (0.989)	**0.90 (0.351)**
No Change, EoM	**0.59 (0.000)**	**0.88 (0.011)**	**0.95 (0.027)**	**0.96 (0.038)**	**0.96 (0.033)**	**0.98 (0.146)**
			Success Ratio			
Futures, EoM	**0.72 (0.000)**	**0.64 (0.000)**	**0.60 (0.015)**	**0.63 (0.002)**	**0.66 (0.001)**	**0.83 (0.000)**
EIA	**0.63 (0.000)**	**0.54 (0.033)**	**0.51 (0.174)**	**0.59 (0.002)**	**0.58 (0.002)**	-
AR	**0.51 (0.254)**	0.47 (0.633)	0.49 (0.280)	**0.55 (0.088)**	**0.59 (0.008)**	**0.61 (0.067)**
VAR	0.47 (0.667)	0.48 (0.425)	**0.53 (0.037)**	**0.55 (0.017)**	0.49 (0.130)	**0.52 (0.475)**
No Change, EoM	**0.72 (0.000)**	**0.62 (0.000)**	**0.58 (0.027)**	**0.58 (0.024)**	**0.59 (0.012)**	0.48 (0.654)

Notes: Real-time forecast performance relative to the monthly average no-change forecast, 1991M1–2022M1. *EoM* refers to end-of-month.

- Stronger long-run predictability mimics behavior of other asset prices

Long-horizon performance of futures has been stable since 2010

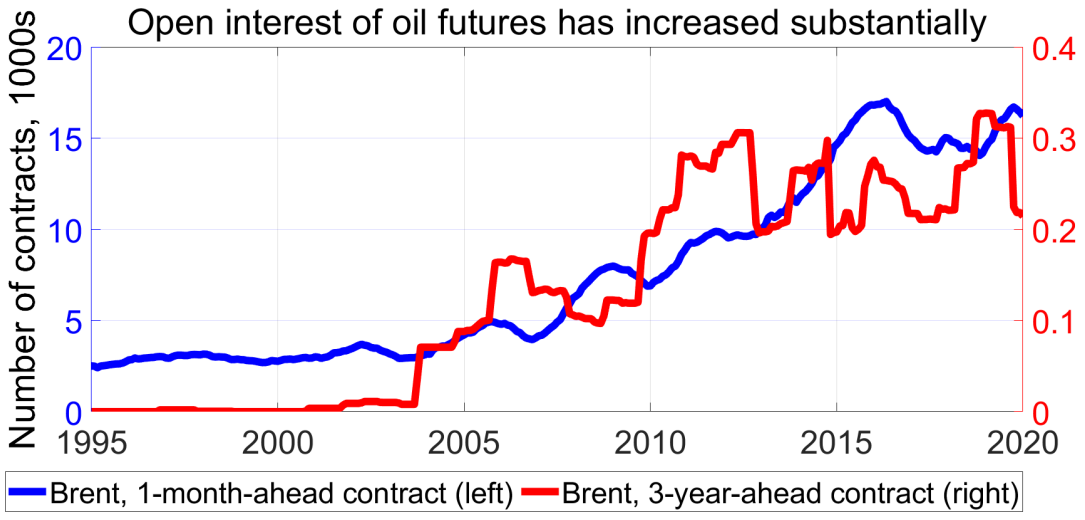




- Futures curves are often mean reverting
- Sustained price increase over mid-2000s weakened performance of futures prices

Increased performance coindices with financialization of commodity futures markets

- Financialization: Influx of new market participants and increase in trading activity



- Potentially *better information* and *smaller risk premium* (Goldstein & Yang 2022; Hamilton & Wu 2016)

$$\text{Futures Price} = \text{Market Expectation} + \text{Risk Premium}$$

Takeaway

- Oil-price forecasts - including futures-based - should be computed with the latest price, not the average price
  - Noticeable gains for up to 1-year-ahead forecasts
  - Informational advantage from latest price $\rightarrow$ publication lags could be a concern for policy makers
- Robust long-horizon performance of futures over the last decade
  - Has financialization contributed to this and how?
- Easy real-time implementation $\rightarrow$ practical value for applied foreasters