1 Introduction

When I presented this project at DUP, I received questions about whether or not producers have an intensive margin response to price changes. Below, I include figures summarizing oil and gas production and how it varies with prices. I define “intensive margin” to capture changes in production intensity at existing wells. I use “extensive margin” to refer to drilling activity to create new wells.

2 Intensive margin response

On the whole, it appears that production at existing wells (defined here to be wells with completion dates before 2015) does not change significantly in response to price fluctuations.

There do appear to be some periods in which prices spike and gas production dips, but many of these (e.g. Jan 2021) occur during cold snaps in Texas, when demand for gas is high and production is disrupted by equipment freezing.

Figure 1: Gas production at existing wells

(a) Gas wells (b) Oil wells

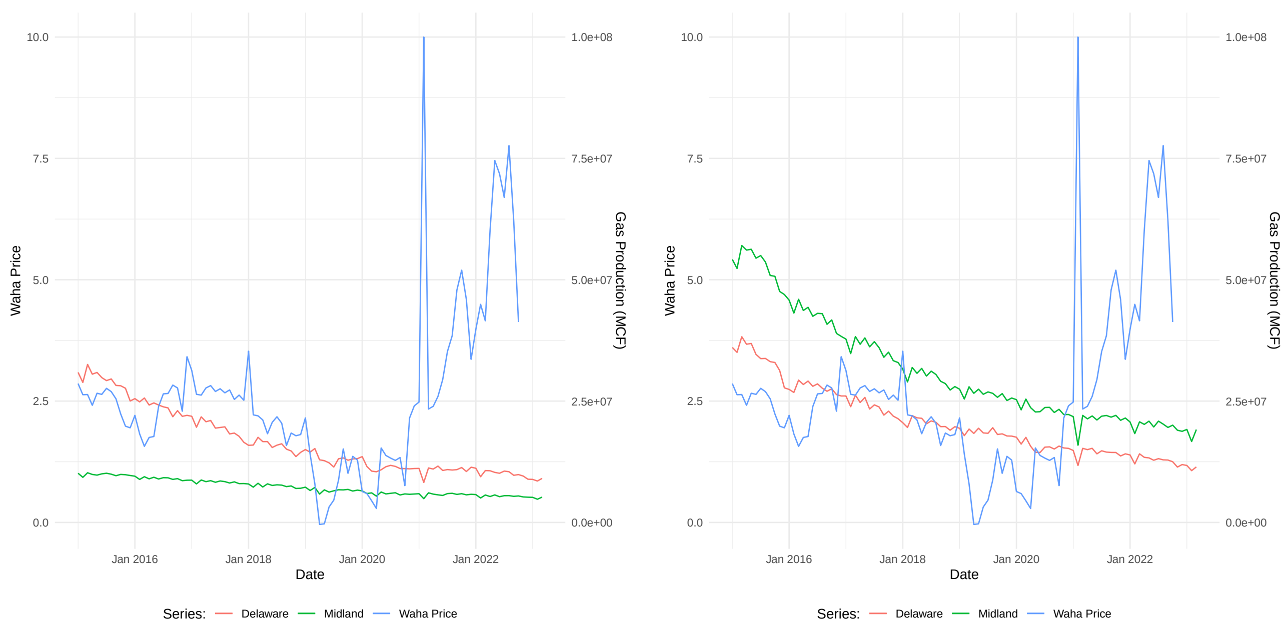
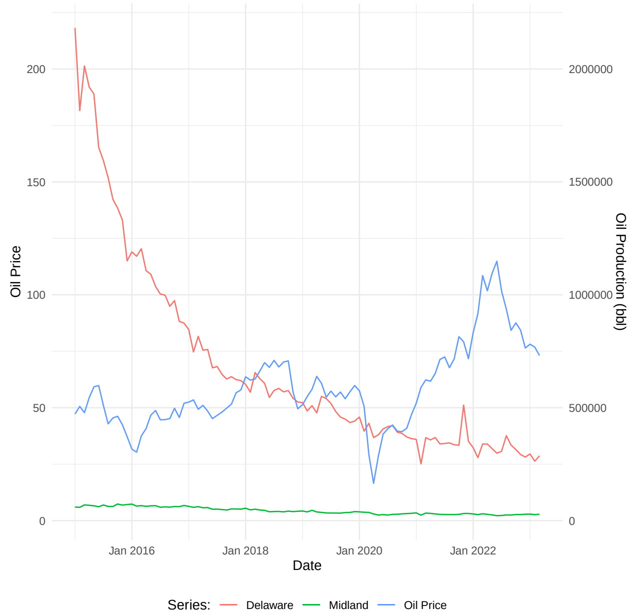


Figure 2: Oil production at existing wells

(a) Gas wells



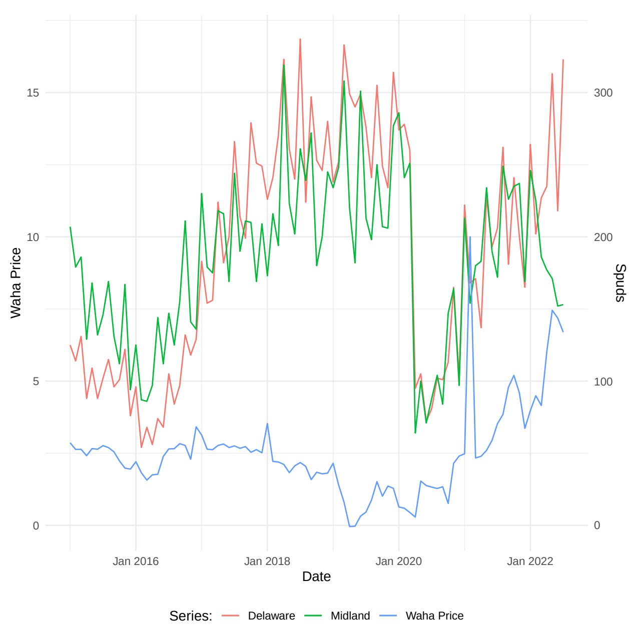
(b) Oil wells

3 Extensive margin

Conversely, well drilling does appear to be strongly related to prices, particularly oil prices (Figure 3, panel b). This appears true in both the Delaware and the Midland basins, even though the Delaware Basin has more primarily gas production.

Figure 3: Well drilling and prices

(a) Gas prices



(b) Oil prices

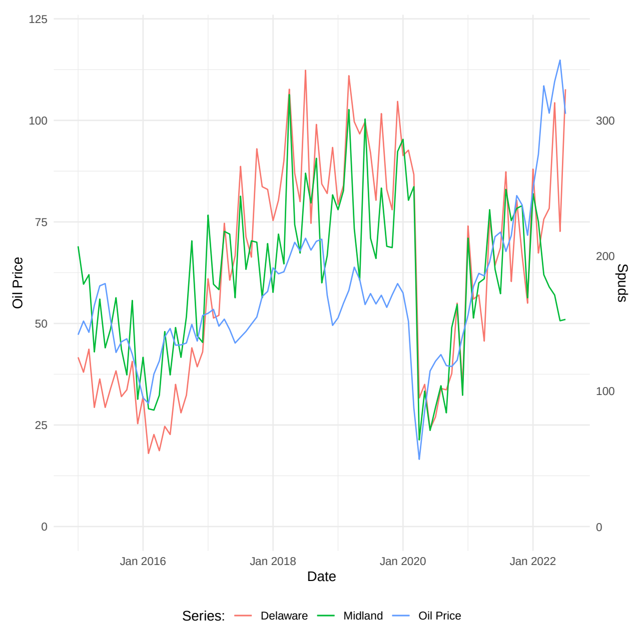
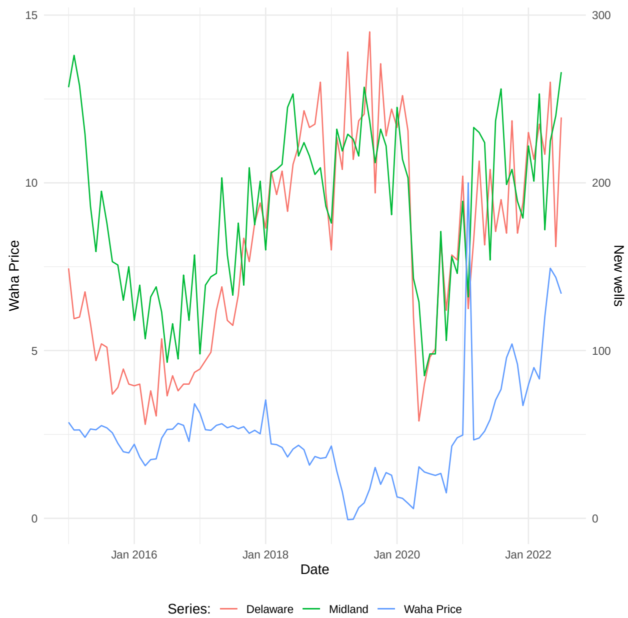


Figure 4: New wells and prices

(a) Gas prices



(b) Oil prices

4 Model recap

We propose a simple model of firm behavior. Oil and gas are co-produced. Production is costly, as is gas capture and transmission. Firms choose production intensity and how much of their gas to capture based on costs and commodity prices.

State variables: p^o, p^g (prices), u (pipeline utilization rate)

Control variables: q^o (oil production), e (emissions rate)

$$\max_{q^o, e\in[0,1]} \underbrace{p^o q^o - c^o(q^o)}_{\text{oil profit}} + \underbrace{p^g[(1-e)q^g(q^o)]}_{\text{gas revenue}} - \underbrace{c_a(1-e)q^g(q^o)}_{\text{capture cost}} - \underbrace{c_t(u)[(1-e)q^g(q^o)]}_{\text{transmission cost}}$$

$$\text{FOC:} \quad \underbrace{p^g - c_t(u)}_{\text{shadow price}} = \underbrace{c_a'(1-e)}_{\text{MACC}}$$

We can estimate the inverse marginal abatement cost curve using some flexible function f (e.g. a spline): $e = f(p^g - c_t(u)) + \varepsilon$.

We can also do a rough calculation of the social cost of insufficient capacity.