**Estimating Shut-In Responses to COVID-19, Spring 2020**

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1. **The Shut-In Option**

The 2020 COVID-19 pandemic posed new challenges to the oil and gas industry that was unique in several aspects. While previous crises in this industry were mainly dominated by supply shocks, for almost the first time, the world encountered a sudden evaporation of the consumers around the world. Pandemics caused significant reduction of urban and air transportation, furthermore it reduced commercial and business sectors power demands. Global oil demand fell by 25% in April, 2020 (Rystad Energy, COVID-19 Report, November 12, 2020).

These rapid changes in the market were enough to persuade many producers to curtail their production after prices crashed in March 2020. (See, for example, Avery 2020, Freeman 2020, and Money, 2020.) Thus, it may be important to understand which producers reduced their production, and which type of wells were more likely to be shut in. Identifying operators who cut their production, and at which wells, can be identified using their monthly/quarterly production reports to the state.

Energy production companies are expected to seek to maximize their profits. In context, this means that when prices are high, they might produce more commodities from a particular well, and then produce less resource from a well when the price is low. In particular, producing companies have the option of shutting in their wells, giving up current income in the hope of receiving higher prices for their products in the future.

The shut in option, however, reduces revenues in the near term for the relevant company. This implies that shut ins will not be viable strategy for firms facing liquidity constraints. Generally, larger firms have more access to capital, and therefore can be expected to more likely to adopt a shut in strategy.

Conceptually, there might be two different strategies a firm might adopt for shutting down wells during a period of low prices. First, a firm might wish to save its resources for higher priced periods. This would imply a firm shutting down its more productive wells. Alternatively, a firm might shut in its least productive wells because they are not generating sufficient revenues to make them profitable in the near term.

The COVID-19 pandemic began to constrain life in the United States in the beginning of March 2020. The U.S. Energy Information Administration reports that petroleum sales in the U.S. fell 25.2 percent from February to April 2020, in contrast to an increase in sales of 7.4 percent from February to April 2019. In contrast, natural gas sales fell 26.0 percent from February to April 2020, similar to the decline of 26.7 percent from February to April 2019. Figure 1 shows the path of oil and natural gas prices day to day during March 2020, setting prices at the end of February as the reference points.

Figure 1. Oil (WTI) prices show significant drops in March 2020 in comparison to the previous month, the natural gas price is relatively stable. Source: Energy Information Administration. Oil prices are for West Texas Intermediate delivered in Cushing, Oklahoma, while gas prices are for gas delivered in Henry Hub, Louisiana.

We note that producers may shut in wells for a variety of other reasons than low prices. One of these reasons could be regular maintenance of surface facilities like pumps, separators or local pipelines that are used for transporting produced hydrocarbons. In addition, shutting in wells can pose technological risks. In particular, plugging a well may harm the geologic features of the well, reducing further production (Gauthier, 2020).

**Project Directions**

Our preliminary research has identified three firms that adopted shut in strategies in response to the COVID-19 outbreak in early 2020. In the Bakken field of North Dakota, those companies are Whiting and XTO. In the Marcellus, the company is EQT, which operated under several names starting with “EQT”

Our directions are for you to first show shut in percentage by month in 2020 for each of these firms FOR THEIR HORIZONTAL WELLS. Then estimate probit models on which wells were shut in after February 2020. (Wells shut in prior to that data should not be included in the dataset.) In the Bakken, you should do models with Whiting and XTO together, and then separately. Then do a statistical test to see if whether combining firms is appropriate. In the probit models, we suggest you determine if shut ins are a function of the size of production from the relevant well, the amount of wastewater or other liquids produced, and the geographic location of the wells.

Once the probit models are complete, we request that you conduct “time to failure” models on how long wells are shut in. This should be done for all three companies. You will want to test whether Whiting and XTO should be combined in your estimations. Again, you will want to use the size of production, the amount of waste liquids produced, and the geographic location of the wells.

Information on well production in North Dakota is available through North Dakota Drilling and Production Statistics at <https://www.dmr.nd.gov/oilgas/mprindex.asp>. . Information on well production in Pennsylvania is available through the Pennsylvania Department of Environmental Protection. at <https://www.depgreenport.state.pa.us/ReportExtracts/OG/OilGasWellProdReport>. Again, Make sure for both states you are using data for horizontal (not vertical) wells.

We define a well as being shut-in if its production is less than half of its production in latest previous month. We define a well as having return to production if its production rises to 75 percent of its level in the pre-shut in month.