Appendix A: Identifying Oil Supply Disruptions and Supply Changes

Posted at http://dahl.mines.edu/B&D18spr/B&D18AppxA.pdf

To Accompany

Bai, Yang and Carol A. Dahl (forthcoming 2018) Evaluating the management of U.S. strategic petroleum reserve during oil disruptions. *Energy Policy*, Special Issue Oil Supply Disruptions, U.S. Economic Activity and Oil Security.

There have been three disruption drawdowns (Beginning with Iraq's Attack on Kuwait August 2, 1990), Hurricanes Katrina (entered Gulf of Mexico August 26, 2005) (http://www.nhc.noaa.gov/outreach/history/#katrina) and Rita (landed in Gulf of Mexico September 21, 2005) http://www.nhc.noaa.gov/outreach/history/#rita, and the Libyan Revolution (beginning February 15, 2011). To isolate them, we go back to data surrounding the disruption and look at oil production in the disrupted area as well as total world production and oil prices. Figure A1 below shows the market changes from Iraq-Kuwait disruption and subsequent Desert Shield (August 2, 1990 –January 17, 1991) and Operation Desert Storm (January 17, 1991 –February 28, 1991).

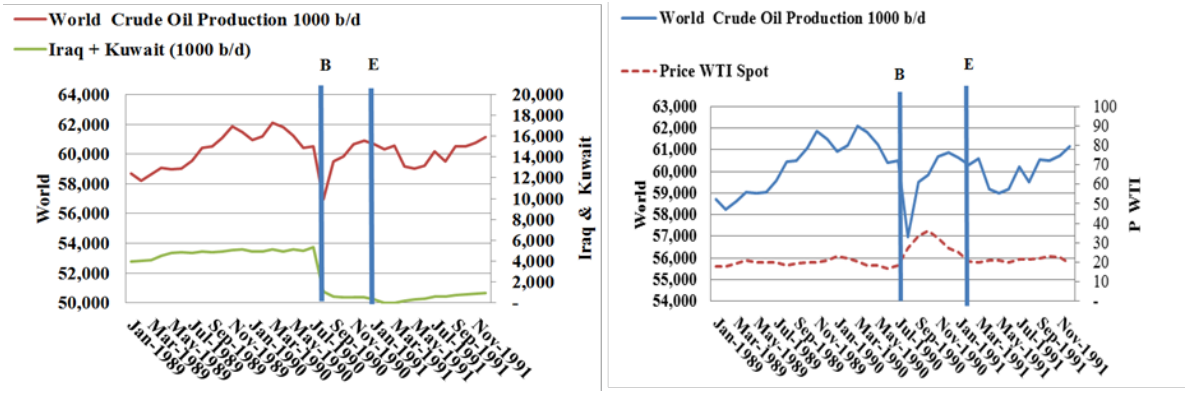

Figure A1: Oil price and oil production for World, Iraq and Kuwait January 1989-December 1991.

Source: Compiled from EIA Data https://www.eia.gov/totalenergy/data/monthly/#international

Production in Iraq and Kuwait fell rapidly beginning in August and stayed quite low. However, world production snapped back much more quickly and had reached pre-disruption production by November but stayed a bit weaker than the same month the previous year and oil prices were elevated until February of 1991 when the rapid crumbling of Saddam Hussein's forces returned confidence to world market. We took the disruption to be from August 1990 – January 1991. With the disruption amount to be the monthly production in each of those months minus the average monthly production from August 1989-July 1990, the average reduction is 1,546,969 b/d. Since production is given in barrels per day, we multiply the deviation by days in the month and average over the relevant 153 days of disruption from August 1990-December 1990 and 0.5 million barrels a day for January over its 31 days.

In 2005, the first hurricane hit the Gulf of Mexico in late August and the second in late September. This disruption is quite straight forward. The figure to the left below shows that the rest of the world had made up the difference by November and the U.S. had recovered by January.

We take the disruption to be for September and October, 2005 with average disruption over the period of 279,100 barrels per day for 61 days.

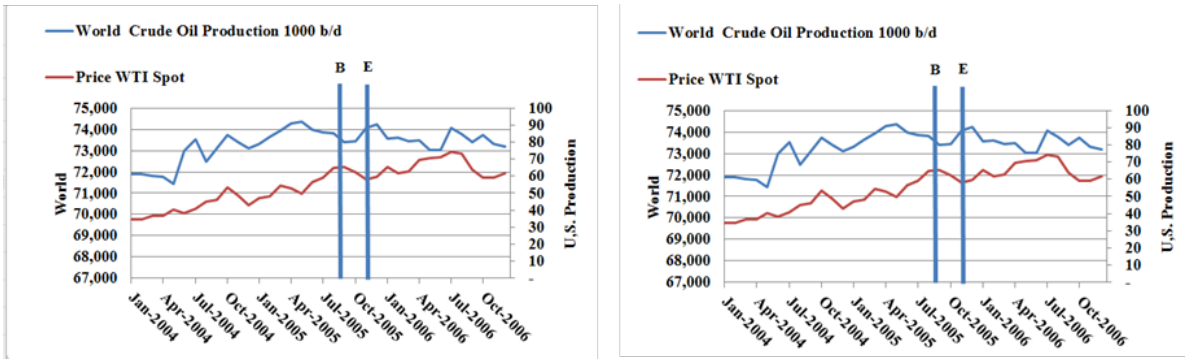

Figure A2 Oil price and oil production for the World and the U.S. January 2004-December 2006.

Source: Compiled from EIA Data https://www.eia.gov/totalenergy/data/monthly/#international

You can see the result of the Libyan revolution, which started in mid February, 2011 in Figure A3.There was a small fall in production for the month of February and for world production with little price response. Libyan production took a steep decline in March and trended down thereafter only starting a weak rebound in August. The rest of the world rapidly started to fill in the shortfall and overall world production reached a minimum in April and thereafter trended up. The world had reached pre-revolution output by November. Prices had been recovering from the global recession before the disruption occurred. They spiked up through March then trended down through August and were then flat or gently rising for many months. We take the disruption to averaging 831,123 from March – July for 153 days.

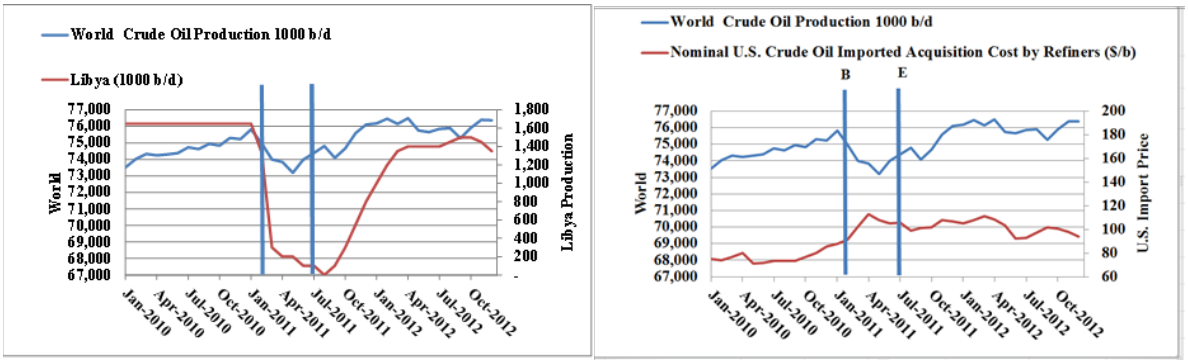

Figure A3 Oil price and oil production for the World and Libya, January 2010-December 2012.

Source: Compiled from EIA Data https://www.eia.gov/totalenergy/data/monthly/#international

Prior to the early 1970s, much of the surge capacity to manage disruptions came from the multinationals and surplus U.S. capacity, managed by the Texas Railroad Commission. That was about to change. By 2005, U.S. oil production had trended down for decades. Nonconventional oil production had staved off the decline a bit but was only about 7% of U.S. oil production. During the historical disruptions in our modeling, most of the additional supply put in the market during disruptions came from the Arabian/Persian Gulf. But U.S. production started its latest takeoff beginning in about 2010 with a dramatic change in that trajectory as shown in Figure A4.

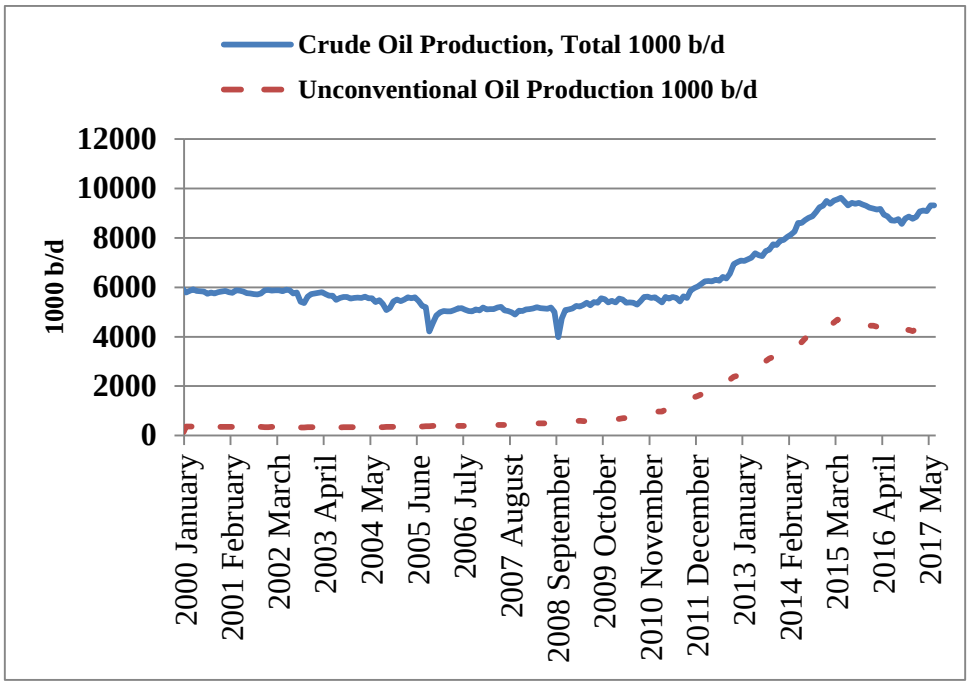

Figure A4: U. S. conventional and unconventional oil production January 2000 to May 2017

Source: U.S. EIA.

By 2011, it had risen to about 18% of U.S. overall production. (EIA Monthly Energy Review). Overall U.S. oil production commenced increasing at a faster rate. Although often cited as a game changer in world oil markets, it is not likely to be much of a game changer in our non-stochastic model. First U.S. production is taken as given, so unconventional are included. We don't expect non-conventional surge capacity during a disruption to be greater than that for conventionals but do allow for it in some of our sensitivity tests. It is more likely its future effects will be larger as safe U.S. supplies become a larger share of world markets and U.S. non-disruption supply elasticities become larger.

**********Last Modified February 14, 2018**********