THE MACRO BULLETIN
Macroeconomic research from the FEDERAL RESERVE BANK *of* KANSAS CITY
APRIL 6, 2015

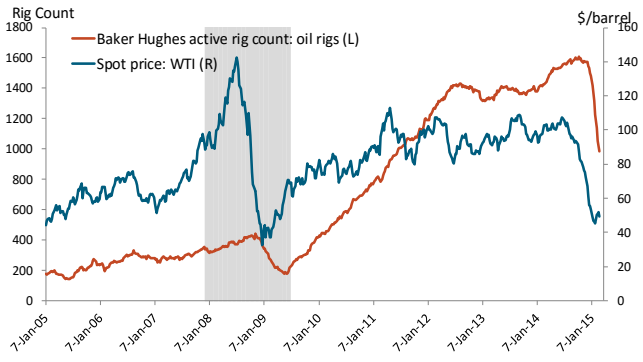
What Could Lower Prices Mean for U.S. Oil Production?

By Nida Çakır Melek

Oil prices and rig counts have declined sharply since last year, calling into question whether the boom in U.S. oil production can continue. Despite highly productive new wells and increasing rig efficiency, U.S. oil production could decline from 0.7 to 8 percent in 2015. For production to increase in 2015, rig efficiency and initial well production would need to increase markedly or the decline in rig counts would need to halt.

U.S. oil and natural gas production has grown significantly since 2005, reflecting a move toward shale gas and tight oil extraction. The most productive tight oil and shale gas fields accounted for almost all of the growth in oil and gas production since 2011, due largely to extensive use of hydraulic fracturing and horizontal drilling. High energy prices made these complementary but costly technologies profitable to be applied on a large scale. However, the recent decline in oil prices—and, subsequently, rig counts—has called into question whether oil production can continue to increase in 2015.

Chart 1: WTI Spot Prices and U.S. Rig Counts



Note: Gray bar denotes NBER-defined recession.
Sources: Baker Hughes and *The Wall Street Journal*.

Chart 1 shows movements in two benchmarks relevant for oil production: West Texas Intermediate (WTI) spot prices and Baker Hughes active rig counts. Oil prices declined around 55 percent from their peak in June 2014 to the end of March 2015, reflecting a combination of changes in demand and supply factors. Oil rig counts declined over 49 percent from October 2014 to the end of March 2015, and could decline further if projected prices are not high enough to make continued drilling in tight oil fields profitable.

To determine the effect of the recent oil price decline on 2015 oil production, the analysis considers two hypothetical scenarios: oil rig counts declining by 50 percent from 2014-15 and oil rig counts declining by 60 percent over the same period. First, the effect of declining rig counts on the number of wells drilled is estimated, which depends both on rig counts and rig efficiency, the number of wells per rig. An average rig can drill more wells today than in the past due to pad drilling. In 2014, the average U.S. rig could drill 22 wells, an efficiency increase of 11 percent from 2011. Individual fields saw even sharper efficiency gains. The analysis considers efficiency gains of 5 and 10 percent in 2015 under each scenario.

Under the first scenario—rigs declining by 50 percent—the total number of oil wells drilled declines by 47 percent, from about 30 thousand to 15.6 thousand, assuming a 5 percent increase in rig efficiency. Assuming a 10 percent increase in rig efficiency, the number of wells drilled declines by 45 percent, from 30 thousand to 16.4 thousand. Under the second scenario—oil rigs declining by 60 percent—the decline in wells, as expected, is sharper. Assuming a 5 percent increase in rig efficiency, the number of oil wells drilled declines by 58 percent compared with a 56 percent decline if rig efficiency increases by 10 percent.

Production from new wells depends critically on a well's initial production (IP)—that is, its production rate when first drilled. The IP of a well is high in shale plays and can vary significantly across and within fields. Since rigs in less productive areas would be removed first in response to lower prices, drilling is assumed to continue in the most productive areas. Using the average IP of a well in the most productive U.S. fields (the Bakken, Eagle Ford, Permian, and Niobrara), overall average IP for U.S. oil production is estimated at about 73 thousand barrels per year. This estimate is assumed to increase in 2015, and the analysis considers one-year IP gains of 5 percent and 15 percent. If rig counts decline by 50 percent, production from new wells is estimated at 1,190 million barrels (assuming a 5 percent rise in both rig efficiency and IP) or 1,365 million barrels (assuming a 10 percent rise in rig efficiency and a 15 percent rise in IP). If rig counts decline by 60 percent, production from new wells would be much less, 952 million barrels and 1,092 barrels, respectively.

However, U.S. oil production depends on production from both new wells and existing wells. Production from existing wells declines over time due to resource depletion, which is faster in shale fields. The average annual decline rate across the top 10 tight oil fields is estimated at about 38 percent. Assuming this decline rate holds in 2015, production from existing wells would be around 1,960 million barrels.

Table 1 combines production estimates from existing wells and new wells to present 2015 production estimates. If oil rig counts decline by 50 percent, rig efficiency increases by 5 percent, and IP increases by 5 percent, then production will decline by 0.7 percent, from 3,168 million barrels in 2014 to 3,147 million barrels in 2015. If rig efficiency increases by 10 percent and IP increases by 15 percent, however, then production will increase around 5 percent to 3,322 million barrels. That is, even with a 50 percent decline in rig counts, improvements in efficiency could mean an increase in production in 2015. A near 7 percent increase in IP could be enough to keep production steady, assuming a 5 percent rise in rig efficiency. However, if oil rig counts decline 60 percent, then even improvements in rig and well efficiency by 10 and 15 percent, respectively, would not be enough to increase production. Under this scenario, production could decline as much as 8 percent. To keep production steady from 2014 to 2015, IP would need to increase more than 27 percent even with a 10 percent rise in rig efficiency.

Table 1: 2015 U.S. Oil Production

Panel A: 50% decline in rig counts	
Improvement in rig efficiency and IP	**Oil production (million barrels)**
5% rig eff. + 5% IP	3,147 (-0.7%)
10% rig eff. + 15% IP	3,322 (+4.9%)
Panel B: 60% decline in rig counts	
5% rig eff. + 5% IP	2,909 (-8%)
10% rig eff. + 15% IP	3,049 (-3.8%)

Sources: Author's calculations, Hughes, EIA, and Baker Hughes.

**Nida Çakır Melek is an economist at the Federal Reserve Bank of Kansas City. For more, see "What Could Lower Prices Mean for U.S. Oil Production?"* Economic Review, *forthcoming. The views expressed are those of the authors and do not necessarily reflect the positions of the Federal Reserve Bank of Kansas City or the Federal Reserve System.*