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More evidence related to the high cost of horizontal drilling and fracking, including questions on the Bakken

Posted by Gail the Actuary on November 2, 2010 - 8:16pm
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[list all tags]

Arthur Berman recently explained why he thinks the Marcellus Shale will disappoint. I was comparing some drilling costs to total revenue, based on EIA data, and I wonder if the problem with high costs might not be quite wide-spread.

Comparing the cost of drilling in a year to total revenue in a given year is in many ways like comparing apples and oranges, because (hopefully) the benefit of drilling will last many years, while revenue relates to accumulated past drilling efforts. But in another way, it is not such a bad ratio to look at, because it tells us what is likely happening to cash flow, and a major change might alert us to a possible problem.

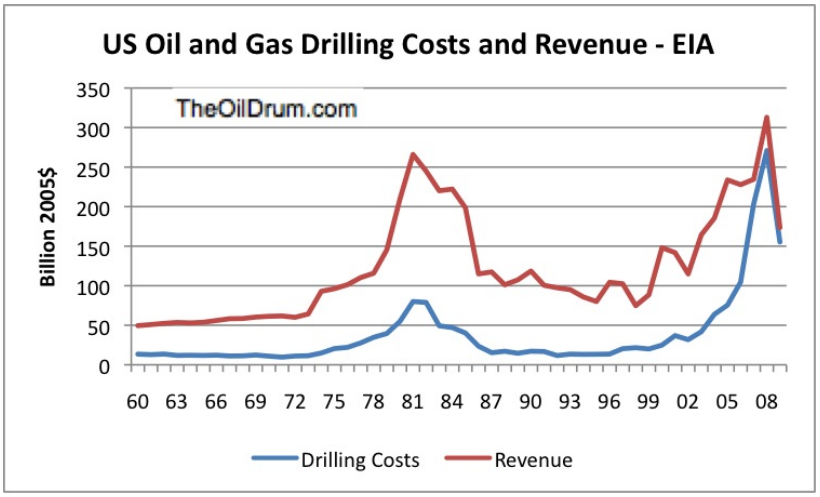

Figure 1. Revenues from Annual Energy Report 3.2 Value of Fossil Fuel Production. Cost of drilling is calculated by multiplying number of wells from Crude Oil and Natural Gas Exploratory and Development Wells, 1949-2009 by the average cost per well from 4.8 Costs of Crude Oil and Natural Gas Wells Drilled, 1960-2008, based on an annual API survey. The 2009 average drilling cost was estimated as the average of 2007 and 2008 drilling costs.

Between 1960 and 2003, oil and gas drilling costs ranged from 12% to 32% of oil and gas revenue, averaging about 21% of revenue. For 2007 through 2009, drilling costs are in excess of 85% of oil and gas revenue. A likely explanation would seem to be the large amount of horizontal drilling and fracking being done now.

Ratio of Drilling Costs to Revenue

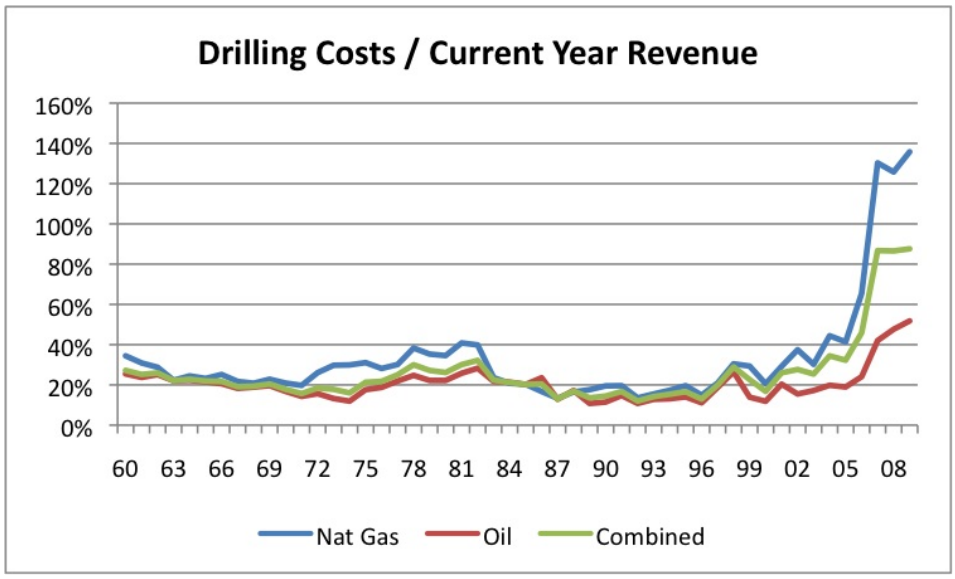

Figure 2. Ratio of drilling costs to total revenue, based on the amounts from Figure 1. The split between oil and natural gas drilling costs is based on the ratio of drilling feet for successful wells.

Since many wells produce a combination of oil and natural gas, attempting to split oil and gas costs is problematic. In Figure 2, I made a rough approximation, and as can be seen, natural gas drilling costs are higher than those of oil. This is not too surprising, given the amount of recent horizontal drilling and fracking for shale gas. Much of the oil would seem to be from wells that have been in place for years, and this would seem to keep drilling costs down, relative to current production.

Clearly, in order for drilling costs greater than 85% of current revenue to make financial sense, production must rise a great deal in the future, or the price of oil and gas must rise a lot, or some combination of the two.

Future Oil Prices

It is not clear how much prices will rise in the future, because high oil prices tend to be recessionary. Dave Murphy has shown that oil prices of $80 - $85 barrel seem to cause recession. This seems to happen because higher oil prices reduce discretionary spending, and this in turn causes recession. The recessionary effect may also reflect the low Energy Return on Energy Investment of high-priced oil. Since the economy needs considerable net energy to maintain its current level, the low EROI may by itself tend to slow down the economy, just as if we attempted to use oil that "cost" more than one barrel of oil to extract.

How High Can Natural Gas Prices be Expected to Go?

What is the price for natural gas that corresponds to the recession-inducing level of $80-$85 barrel for oil? This is not immediately obvious. While people often use "barrels of oil equivalent" (BOE) based on heat values to equate natural gas to oil, natural gas prices are virtually never this high in the US.

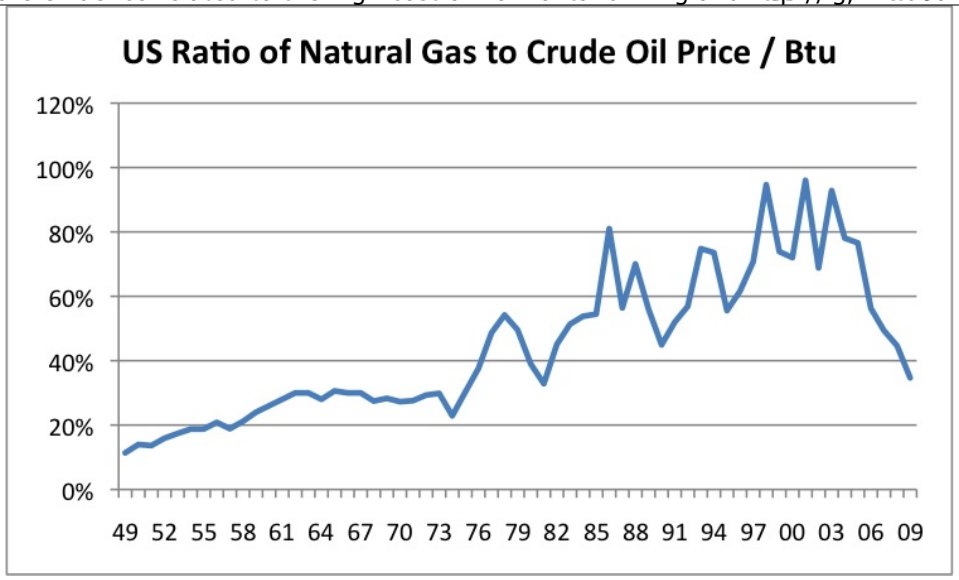

Figure 3. Based on 3.1 Fossil Fuel Production Prices, 1949-2009, where the natural gas price is the wellhead price and the oil price is the "Crude Oil Domestic First Purchase Price," both on a Btu basis.

Figure 3 shows that the ratio of natural gas prices to crude oil prices has varied greatly. In periods of natural gas shortages, natural gas has sometimes traded above 80% of the price of crude oil, but in general, the price has been lower--often much lower. A more reasonable estimate might be that natural gas prices can be expected to be roughly 60% to 70% of oil prices, on a Btu basis. Thus, instead of being 1/6 of the oil per-barrel price (which one might expect based on Btu values), a better estimate might be (1/6 x 60% = 10%) to (1/6 x 70% = 11.7%) of the oil per barrel price.

Using these ratios, the rough upper limit for natural gas prices without inducing recession might be $8 to $10 per million Btu (based on a range of 10% x $80 = $8 to 11.7% x $85 = $10). If natural gas prices can be expected to stay below $8 to $10 per million Btu in real terms (except for brief recession-inducing spikes), this means that there must be a very large increase in future natural gas production to justify the current high natural gas drilling costs, because companies have considerable expenses besides drilling costs. Either that, or the costs are too high relative to the revenue that can be obtained from natural gas--pretty much what Art Berman has been saying about the Marcellus Shale.

Bakken Oil Drilling Costs

I started wondering about the Bakken oil in North Dakota, also. This is shale oil, which is extracted using horizontal drilling and fracking. If I look at the Baker Hughes rig count report, I find numbers which can be graphed as follows:

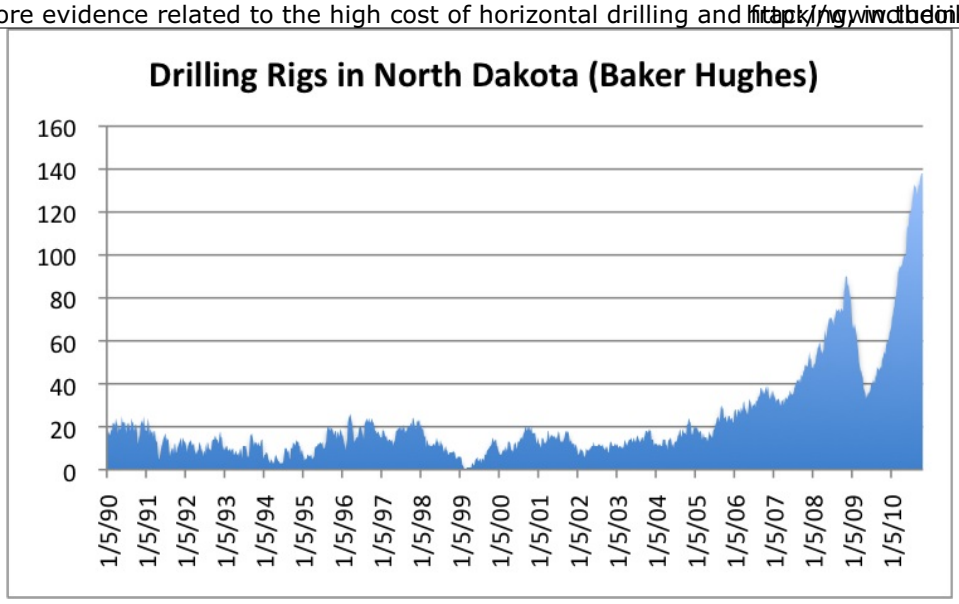

Figure 4. North Dakota Drilling Active Rotary Rig counts, based on data of Baker Hughes.

As of the latest report, the number of active drilling rigs is 138. If we estimate that these drilling rigs can drill two wells a month, or 24 a year, apiece, then in a year, a total of 3,312 wells will be drilled. If each of these wells costs $5 million, then we are talking $16.6 billion a year in drilling costs.

On April 5, 2010, Downstream Today issued a report called Platts Unveils New Bakken Price Assessment. Among other things, it says

> Platts reports that current Bakken crude output is about 200,000 barrels per day (b/d) and the North Dakota Pipeline Authority estimates that the field's yield could rise quickly to between 400,000 b/d to 500,000 b/d over the next 10 years before tapering off.

The report also indicates

> The world's first price assessments valuing crude oil produced from the Bakken Shale formation in the central United States will be published by Platts beginning May 3, 2010.

I did not find the new Platt's price. The Downstream Today report compares the oil to North Dakota Sweet, or to North Dakota Light Sweet. North Dakota Sweet is currently trading at $62.70 barrel, which is $20+ below WTI crude.

Suppose that companies operating in North Dakota produce 500,000 barrels a day of crude oil, at $62.70 barrel. The total revenue will be 500,000 x $62.70 x 365 = $11.4 billion a year. So clearly drilling at $16.6 billion a year, estimated above, had better not go on for very long, or oil prices need to be much higher. Raising the price of oil to that of WTI would help somewhat, but not a lot.

All of the calculations oil and gas companies give to their investors are made using assumptions about how productive wells will be, what their decline rates will be, and how long they will be economic. It is very easy to be over-optimistic. These initial Bakken numbers suggest that it too, will generate very high drilling costs--costs which it is not clear can be recovered over the long haul.

General Issues

One of the issues we are running into now is that to an ever greater extent, new energy production costs are very much "front ended". This is true for solar photovoltaic panels, and for wind turbines, for deepwater production requiring more elaborate drilling platforms (or "spars"), and now for horizontal wells with fracking. There are multiple difficulties with these high front-end costs. One of the issues is simply financing them all, since it is hard to finance them through cash flow. Another issue is the natural tendency to be over-optimistic regarding how valuable the current investment will be, and to underestimate the ongoing costs required to continue to make the investment economic.

Clearly this type of analysis in this post is only of the type one can do on the back of an envelope. But it, together with the questions Art Berman has raised earlier, makes one wonder whether a more detailed analysis is needed, where ever drilling costs are very high relative to revenue. It is possible that everything will turn out all right in the long run, but it is also possible that companies making the projections are being over-optimistic in their assessments.