



Empirical Relationships Between Reserves and Production Rates

Posted by [Sam Foucher](#) on November 9, 2007 - 12:01pm

Topic: [Supply/Production](#)

Tags: [oil reserves](#), [saudi arabia](#), [urr](#) [[list all tags](#)]

A very short post before the weekend. I always wondered if there was a quick way to derive the expected production rates per day from the total recoverable oil volume (URR). That can be handy, when a new oilfield discovery has been announced for instance. More below the fold.

In a recent article:

Pickering, A., *The Oil Reserves Production Relationship*, Energy Economics (2007). [abstract](#).

Andrew Pickering established the following empirical relationship between proven reserves (R) and extraction rates (P):

$$P = aR + b$$

He then estimated a and b for three different group of countries using data from 1980 to 2002:

- OPEC: $a = 0.0096 \text{ mbpd/Gb}$, $b = 0.2323 \text{ mbpd}$
- Fringe: $a = 0.0466 \text{ mbpd/Gb}$, $b = 0.093 \text{ mbpd}$
- Small Fringe : $a = 0.0435 \text{ mbpd/Gb}$, $b = 0.0418 \text{ mbpd}$

The Fringe group includes large non-OPEC extractors such as Canada, China, Mexico, Norway, Russia, the UK and the US. The small fringe is formed of the rest of the small non-OPEC extractors. We can already see that the first group has a very small values for the slope (a) compared to the other two groups which is not surprising because available proven reserve figures for OPEC are largely [overstated](#). For fun, I hacked this simple linear relation in order to get a rough estimate of the total URR:

$$URR \sim Q(y_{max}) + (P_{max} - b) / a$$

Where y_{max} is the year of maximum production (P_{max}) and $Q(y_{max})$ the cumulative production. For instance, for Saudi Arabia you have $y_{max}=1980$ with $P_{max}=9.9 \text{ mbpd}$ (Crude Oil + condensate) and $Q(1980)=42.41 \text{ Gb}$. Using the OPEC parameters, we get 1,005 Gb! However, using the other two sets of parameters, we get :

Saudi Arabia (Fringe): $42.41 + (9.9 - 0.093)/0.0466 = 253$ Gb

Saudi Arabia (Small Fringe): $42.41 + (9.9 - 0.0418)/0.0435 = 269$ Gb

hmmm! These values seem strangely [familiar](#).

Other countries:

Russia: 1.3 Tb (OPEC), 333 Gb (Fringe), 352 Gb (Small Fringe)

US (Lower 48): 956.5 (OPEC), 200 Gb (Fringe), 216 Gb (Small Fringe)

and finally, what about the entire world production? Using, $y_{max}=2005$ with $P_{max}=73.58$ mbpd (Crude Oil + condensate) and $Q(2005)=1,011$ Gb:

8.7 Tb (OPEC), 2.6 Tb (Fringe), 2.7 Tb (Small Fringe)

Lately, a major oil find (Tupi field) has been announced by Petrobras (Brazil) [yesterday](#). 5-8 Gb of recoverable oil, that should give between 260 and 390 kbpd using the Small Fringe parameters. However, Exploration and Production Director Guilherme Estrella [said](#): "*Petrobras could possibly produce 100,000 barrels a day at Tupi by 2010 or 2011*". Using this 100 kbpd figure, we get a recoverable oil volume estimate between 0.15 Gb and 1.34 Gb.



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