A Note on the Rate of Depletion of World Oil Reserves Determined by Combining Skrebowski Analysis with the Parabolic Model developed to Project Future Production based upon Geological Resource Assessments

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Oil is produced from individual projects undertaken to exploit reserves established through the process of discovery within the resource base of undiscovered oil. It frequently takes up to ten years after the first discovery to reach regular production of conventional oil at a given project. This time gap makes it possible to estimate future new world oil production in the near term by simply identifying the individual projects as they reach fruition. It has become the practice to count only the so-called megaprojects around the world to assess the total output of new oil coming on stream in a given year as the smaller projects are too minor to affect the result in any significant way. Alternatively, an arbitrary correction or addition can be made to the list of completed projects to compensate for this generally small error in a very uncertain field of study. Generally, there are some seventy-five megaprojects underway around the world at any one time.

The output from these identified projects is totalled as each reaches the production stage. The necessary information required may be gleaned from company announcements, trade sources, government reports, and the like. The advent of the internet makes it possible to prepare a list in the form of a Wiki to which omissions and other corrections may be made by many observers throughout the world which increases the probability of accuracy.[1] The public availability of satellite photos also provides a confirming tool. Since individual projects, especially those undertaken in hostile or deep water or cold environments, are more likely to be late than early in reaching production, judgement must be applied to published announcements of progress. The total represents the production from new sources coming into service by year in the near future. The development of this technique has been associated with the work of Chris Skrebowski, the former editor of the *Petroleum Journal* in London[2].

In this note, the production in a given year is taken as the sum of the output in the previous year *plus* the production added during the year from new sources *less* the yearly depletion in the production from the pre-existing (or old oil) reserves. It is this statement which is novel in this note. In mathematical terms, this relationship may be represented as:

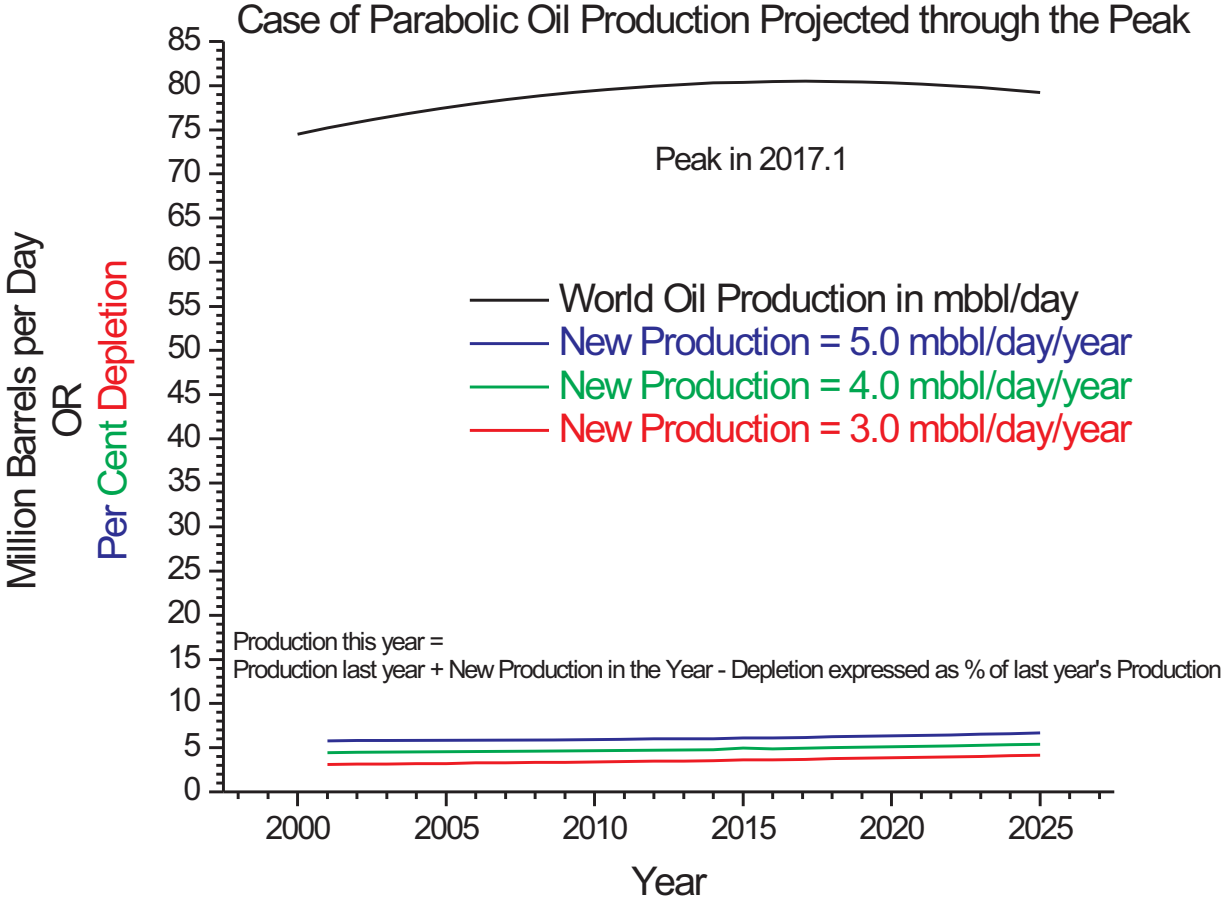
$$p_y = p_{y-1} + New\ \mathrm{Pr}oduction - Depletion\ in\ Old\ \mathrm{Pr}oduction$$

The depletion (D) may be expressed as a percentage decrease in the production in the previous year expressed as $d = {D}/{p_{y-1}} \times 100.$

The New Production (NP) must be greater than zero and thus always positive, while the Depletion, though usually positive as written, can actually be negative in extreme cases. This latter situation can arise because the depletion, as defined by the equation, represents all changes occurring to the old oil during the course of the year in question such as increased production from additional infill drilling, and the introduction of enhanced oil recovery practices and other improved methods of extending the reserve base. Together these could, in exceptional cases, overwhelm the depletion value when defined in the traditional narrow sense.

In this note, three cases for New Production were chosen ranging from 3 to 5 million barrels per day on an annualized basis based upon the range of values reported in the megaprojects total published in the summary list on the Web. This level of new production each year will be assumed to stay constant through the chosen

Figure 1: Rate of Depletion of World Oil Reserves in a Case of Parabolic Oil Production Projected through the Peak



study period although there are signs of a gradual decline in maturing new projects over time.

The equation was modified to the following form to allow computation of the percent decline:

$$\% d = \frac{[P_{y-1} + NP - P_y]}{P_{y-1}} \text{ x } 100$$

The substitution of historical data taken from the *BP Statistical Review of World Energy* for the ten year period from 1999 to 2009 leads to erratic numbers ranging from 0.71% to 7.38% (average: 4.1%) for the percent depletion for the middle case of four million barrels per day per year of New Production. This data can be smoothed somewhat by employing three-year rolling averages.

In Figure 1, a parabolic production scenario taken from a previous publication was applied through the time of the projected peak and beyond over a period of twenty-four years [3]. This scenario in this paper was based upon the Average Expectation assessment of undiscovered world oil resources published by the U.S. Geological Survey in 2000 using a technique developed by this author. The peak was projected to occur in 2017 as shown in the Figure 1. The three cases assumed of New Production

were used to evaluate the equation year-by-year with the aid of a mathematics program.

For the most likely case for the New Production - four million barrels per day new each year - the percent depletion increases slowly over this period from 4.4 to 5.4% per year as illustrated in the figure.

This range of values may be compared with those of Foucher who found the world percent depletion to be of the order 4.35% as representative of the cases in his study.[4] It appears that the melding of the Skrebowski and the parabolic projection techniques provide results that are both internally self-consistent and in general agreement with other published studies.

References

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