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The Peak Oil Theory

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A statement of the type 'All men are mortal; Socrates is a man; therefore Socrates is mortal' does not constitute a prediction but the deduction of a self-evident truth. To say that an exhaustible resource will be exhausted is not a prediction but, under certain conditions, a tautology. The only qualification is that an exhaustible resource will not be exhausted if , for some reason, production ceases while reserves are still available.

The statement that the production of crude oil, an exhaustible resource, will reach a peak will not be entirely a tautology if it also told us something about the production pattern over time; something that is not necessarily implied in the exhaustibility concept. The peak story tells us, indeed, that after rising over years, decades or centuries, production will enter a phase of decline. The peak could take different shapes however. It could appear as the apex of an acute angle, or stretch out over a long period in the form of a plateau, or emerge more than once in the shape of a saddle or as a chain of dunes.

In short, it is not sufficient to say that an exhaustible resource will be eventually exhausted and that its production will decline until extinction after reaching a peak. These are not predictions. Such statements are of no interest whatsoever unless we are told the dates at which the peak will be reached, and the likely shape of the production curve before and after the peak.

Socrates knows that he is a man and as such a mortal being. What he would like to know is when exactly he will die and in which manner.

The authors and promoters of the peak oil theory clearly understand that a prediction must relate to the date at which the relevant event – the production peak – will occur. They did indeed stick their necks out and told us once that the peak will be reached in the late 1980s, then in 2000, then in 2005. They proved to be wrong on all occasions. World oil production is still rising year after year.

One major reason for their propensity to bring forward the dreaded event seems to be an eschatological inclination. Consciously or sub-consciously they are inclined to predict the end of a world economy that was fuelled by cheap oil over several decades. They also want to catch the headlines. For these reasons they need to predict an early peak. To tell us, for example, that oil production will peak in 2030 and oil resources be fully exhausted by 2080 would have little impact. The prediction has to be about an imminent event.

I do not know when the oil production will be reached. I accept as evident that unless world oil demand collapses in a significant way a peak of some shape will inevitably obtain. We need to examine the methodologies underlying current predictions about the imminent peak in order to assess their plausibility.

The first set of methodological problems relates to the definition of four relevant concepts: crude oil, production, reserves and resources.

One may think that the term ‘crude oil’ is defined with great precision. It is not. The reason is that the substance referred to as ‘crude oil’ occurs under a wide variety of physical, chemical and geological circumstances. Thus the physical nature of that substance varies along a continuum from very viscous (e.g. bitumen) to liquid, to condensates (gases that are liquid such as dew at certain temperatures). But where are the border lines between viscous and liquid, viscous and solid, liquid and gas? These questions are subject of much disagreement and controversies. The issue is important

because the world holds huge reserves of tar sands, especially in Canada, and in the Orinoco belt bitumen in Venezuela. These are usually referred to as 'unconventional oil'. Several peak oil theorists base their analysis on conventional oil (liquid and condensates) only. Yet unconventional oil is being currently produced albeit in small quantities. These volumes will undoubtedly rise over time in response to an eventual tightening of conventional oil supplies.

This takes us to the reserve/resources concepts. Production is a function of extant reserves among many other factors. It is thus important to have an idea about the volume of remaining reserves. Estimates of proven reserves by country or region are available in a number of publications such as the *Oil and Gas Journal*, the *BP Statistical Review of World Energy*, etc. These data cannot be relied upon however. The reasons are many. First, the criteria used to estimate proven reserves specify that they must be recoverable under 'current operational and economic conditions'. These criteria are ambiguous and require judgements about which reasonable people may reasonably differ. Do operational or technical conditions refer to the technology actually used in the oilfield that holds the reserves or to the best technology currently available in the world? Economic conditions include prices, costs and taxes. Prices are volatile however; costs and taxes change over time for a variety of reasons. Did proven reserve estimates made in 1998 assume that oil prices will hold at around $12 a barrel; and are current estimates made on the assumption of a $30, or $45 or $60 oil price?

Secondly, proven reserves estimates may be understated by oil companies that are negotiating production agreement with a host country, or overstated in discourses addressed to equity analysts or fund managers. OPEC countries may have overstated their reserves estimates in the 1980s when they engaged in major revisions in the context of intra-OPEC negotiations over production quotas.

Thirdly, some countries specify the criteria that should be used in estimating proven reserves. The US criteria are particularly stringent leading to understatements by companies that report to the US regulatory authorities.

Finally, proven reserves are not the same thing as remaining recoverable reserves. The latter is the relevant concept for determining the likely points of peak production and ultimate exhaustion.

Remaining recoverable reserves involve besides the proven concept that of probable and possible reserves. They also involve views about recovery rates. Put differently the remaining reserves consist of what is left of the oil already discovered plus as yet undiscovered oil. Different degrees of probabilities are attached to the undiscovered reserves; hence the distinction between probable and possible. There is a greater probability to find the 'probable' than the 'possible' reserves.

A deterministic approach to the estimate of remaining reserves will equate them to the difference between ultimate reserves (discovered plus undiscovered) and cumulative production. One need, however, an independent estimate of undiscovered reserves to avoid circularity since ultimate reserves includes undiscovered, and undiscovered is the difference between ultimate and discovered reserves.

A probabilistic approach is to be preferred for the simple reason that much uncertainty is attached to undiscovered reserves.

Without going much further one can already see that assumptions and judgements, all subject to difference of views and debate, are involved at every stage of the exercises that lead to estimates of how much oil still remains in the ground, and of when peak production may be reached. In assessing the work and results of the proponents of the peak oil theory (by which I mean those who are predicting an imminent production peak) the following initial questions should be asked.

First, is the crude oil concept used the narrow one (liquids plus condensates) or the broader definition that includes tar sands and bituminous deposits?

Secondly, is the phenomenon of 'reserve growth' taken into account in the estimates of proven and remaining reserves? The initial assessment of a field reserves grossly underestimates the volumes available. As production proceeds knowledge about the amounts of oil held by the field improves, and in many cases the new information thus obtained reveals that the reserves are larger than initially thought.

Thirdly, as proven reserves are estimated on the basis of what can be produced *under current operational/technical and economic conditions* the potential is understated if long run changes in oil prices and technology are not taken into account. Oil prices are bound to rise with costs as production shifts from big, well-behaved fields to smaller and often more difficult formations. The question is whether the net price (that is price minus costs) will then rise or fall. In my judgement the net price will tend to increase in many instances. This provides an incentive to adopt technologies leading to rises in the recovery rate. Technical progress is a critical factor. The techniques used in exploration and oil production are being continually developed. And the remarkable progress already achieved will undoubtedly be followed by further progress. Where adopted, these new technologies improve both the rate of discoveries and the recovery rate from discovered fields.

A failure to allow for the effects of technology on the recovery rate results in a significant understatement of the volumes that can be ultimately produced. To illustrate the point: an increase in the recovery rate from the historical 25-30 per cent to 50-55 per cent that recent technology enables is equivalent to a 66-100 per cent increase in reserves from existing oil provinces even if no new discoveries are made.

The authors of the peak oil theory ignore one or several of the points made here above. This results in predictions of a more imminent production peak and an earlier exhaustion than will actually happen.

Nevertheless the peak oil theorists are right on two issues: the significant decline in discoveries which peaked as long ago as in 1961 and the recent failure of discoveries to replace the full amount of oil produced. This tells us that oil is being depleted and that exhaustibility is a real issue. It does not answer, however, the *when* question.

Yet time is of the essence.

Exhaustibility is not a problem if there is time available to develop substitutes, and for technological progress to proceed further and delay the peak outcome. There is no doubt that the adjustments to scarcer and scarcer (which means more and more expensive) oil will occur. The critical question, once again, is 'when?' Once again one should emphasise that time is of the essence. The gestation lags of R&D and energy investments are long, sometime very long indeed. And investors – be it private companies or public sector entities – are increasingly slow in their responses because the future is always perceived as uncertain.

The peak oil theory, as defined above, has a harmful impact because it focuses on the wrong problem and in doing so it shifts attention away from more vital issues.

Oil is of critical importance for the transport sector given the current technology of car, truck, plane and ship engines. But what matters is not oil as such but a liquid fuel. Alcohol, esters, vegetable oils are liquids which are indeed used to fuel motor engines. And there are technologies which yield petroleum products from natural gas (GTL) and coal (CTL). And the reserves of unconventional oil in Canada and Venezuela in particular are immense.

There is no 'physical' problem in the long run. There are, however, investment problems on the transition path from the oil to the 'other liquids' era. The ride is likely to be bumpy. And what we need to worry about now, and seek solutions to, are the investment and technical progress issues. Governments of OECD countries and private energy companies are not yet addressing these problems, worrying instead about the imminence

of peak oil (a falsely alarming issue) for the security of energy supplies (a grossly misunderstood concept) and climate change (the most important about which the most significant polluters are unwilling to tackle.)

Re-focusing the debate away from the peak oil paranoia and towards the need to invest in the production of liquid fuels *at the right time* will put us on the road to a solution.