系所組別 資源工程學系丙組

考試科目 資源管理問題解析

考試日期 0307 節次 2

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以下四題（每題占25分）請詳讀題目後說明(1)該題目之主要重點（占15分）及(2)該題目在資源管理之意涵（占10分）。

（資料來源 - Tom Tietenberg and Lynne Lewis (2009) Environmental & Natural Resource Economics, 8th Edition, Pearson International Edition）

（一） The Kakadu Conservation Zone (KCZ), a 50-square-kilometer area lying entirely within the Kakadu National Park (KNP), was initially set aside by the government as part of a grazing lease. The current issue was whether it should be mined (it was believed to contain significant deposits of gold, platinum, and palladium) or added to the KNP one of Australia's major parks. In recognition of its unique ecosystem and extensive wildlife as well as its aboriginal archeological sites, much of the park has been placed on the U.N World Heritage List. Mining would produce income and employment, but it could also cause the ecosystems in both the KCZ and KNP to experience irreversible damage What value was to be placed on those risks? Would those risks outweigh the employment and income effects from mining?

To provide answers to these crucial questions, economists conducted a benefit/cost analysis using a technique known as contingent valuation.

The value of preserving the site was estimated to be A$435 million, while the present value of mining the site was estimated to be A$102 million

According to this analysis, preservation was the preferred option and it was the option chosen by the government.

（二） One interesting example of an intergenerational sharing mechanism currently exists in the State of Alaska Extraction from Alaska's oil fields generates significant income, but it also depreciates one of the state's main environmental assets. To protect the interests of future generations as the Alaskan pipeline construction neared completion in 1976, Alaska voters approved a constitutional amendment that authorized the establishment of a dedicated fund: the Alaska Permanent Fund. This fund was designed to capture a portion of the rents received from the sale of the state's oil to share with future generations. The amendment requires

> *At least 25 percent of all mineral lease rentals, royalties, royalty sales proceeds, federal mineral revenue-sharing payments and bonuses received by the state be placed in a permanent fund, the principal of which may only be used for income-producing investments.*

The principal of this fund cannot be used to cover current expenses without a majority vote of Alaskans

The fund is fully invested in capital markets and diversified among various asset classes It generates income from interest on bonds, stock dividends, real estate rents, and capital gains from the sale of assets To date, the legislature has used some of these annual earnings to provide dividends to every eligible Alaska resident, while using the rest to increase the size of the principal, thereby assuring that it is not eroded by inflation.

Although this fund does preserve some of the revenue for future generations, two characteristics are worth noting First, the principal could be used for current expenditures if a majority of current voters agreed. To date, that has not happened, but it has been discussed Second, only 25% of the oil revenue is placed in the fund; assuming that revenue reflects scarcity rent, full sustainability would require dedicating 100% of it to the fund. Because the current generation not only gets its share of the income from the permanent fund, but also receives 75% of the proceeds from current oil sales, this sharing arrangement falls short of that prescribed by the Hartwick rule.

（背面仍有題目,請繼續作答）

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(三) As a cartel, OPEC (Organization of Petroleum Exporting Countries) has some control over its prices It could increase its profits by restricting supply, a tactic that would cause prices to rise above their competitive levels By how much should prices be raised?

The profit-maximizing price will depend upon several factors, including the price elasticity of demand (to determine how much the quantity demanded will fall in response to the higher price), the price elasticity of supply for non-OPEC members (to determine how much added production should be expected from outside producers), and the propensity for cheating (members producing more than their assigned quotas) Gately (1995) has modeled these and other factors and concluded that OPEC's interests would be best served by a policy of moderate output growth, defined as growth at a rate no faster than world income growth.

As Gately points out, however, OPEC historically has not always exercised this degree of caution. In 1979–1980, succumbing to the lure of even higher prices, OPEC chose a price strategy that required substantial restrictions of cartel output. Not only did the price elasticities of demand and non-OPEC supply turn out to be much higher than anticipated by the cartel, but also the higher oil prices triggered a worldwide recession (which further lowered demand) OPEC not only lost revenue but also market share. Even for monopolies, the market imposes some discipline; the highest price is not always the best price.

Interestingly, since 1980, world oil markets have experienced increasing price volatility. Oil prices dropped as low as $10 per barrel in 1998 and rose above $30 per barrel in 2000 (then considered a huge price swing). In 2008 oil prices rose to over $138 per barrel! Kohl (2002) analyzes OPEC's behavior during the period of 1998–2001. He notes that OPEC has consistently had trouble with member compliance and with the non-OPEC competitive fringe (for example, Norway, Mexico, and Russia). He notes that compliance with production quotas has been best during periods of high demand or when the quotas are set above production capacity.

High demand was the situation in 2008. With surging demand in China and the United States, oil prices have risen dramatically. Will higher prices induce sufficient reductions in consumption to moderate OPEC power? Stay tuned.

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(四) When can we expect to run out of oil? It's a simple question with a complex answer In 1956 geophysicist M King Hubbert, then working at the Shell research lab in Houston, predicted that U.S. oil production would reach its peak in the early 1970s. Though Hubbert's analysis failed to win much acceptance from experts either in the oil industry or among academics, his prediction came true in the early 1970s. With some modifications this methodology has since been used to predict the timing of a downturn in global annual oil production as well as when we might run out of oil

These forecasts and the methods that underlie them are controversial, in part because they ignore such obvious economic factors as prices. The Hubbert model assumes that the annual rate of production follows a bell-shaped curve, regardless of what is happening in oil markets, oil prices don't matter It seems reasonable to believe, however that by affecting the incentive to explore new sources and to bring them into production, prices should affect the shape of the production curve.

How much difference would incorporating prices make? Pesaran and Samiei (1995) find, as expected, that modifying the model to include price effects causes the estimated ultimate resource recovery to be larger than implied by the basic Hubbert model. Moreover, a study by Kaufman and Cleveland (2001) finds that forecasting with a Hubbert-type model is fraught with peril

> . *production in the lower 48 states stabilizes in the late 1970's and early 1980's, which contradicts the steady decline forecast by the Hubbert model. Our results indicate that Hubbert was able to predict the peak in US production accurately because real oil prices, average real cost of production, and [government decisions] co-evolved in a way that traced what appears to be a symmetric bell-shaped curve for production over time. A different evolutionary path for any of these variables could have produced a pattern of production that is significantly different from a bell-shaped curve and production may not have peaked in 1970. In effect, Hubbert got lucky. [p. 46]*

Does this mean we are not running out of oil? No. It simply means we have to be cautious when interpreting forecasts of the timing of the transition to other sources of energy. In 2005 the Adminsitrator of the U.S. Energy Information Agency presented a compendium of 36 studies of global oil production and all but one forecasted a production peak. The EIA's own estimates range from 2031 to 2068 (Caruso, 2005) The issue, it seems, is no longer whether oil production will peak, but when