Notes & Comments

The Economic Price of Natural Gas in Pakistan

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"When argument is based on wildest of delusions there sometimes emerge most original conclusions." From Henrik Ibsen's *Peer Gynt*, Act 4, Scene 9.

The World Bank Study, *Water and Power Resources of West Pakistan* [1], is one of the most thorough-going and sophisticated of its type. In re-reading it we have been struck by a curious argument related to the real benefits to be expected from the construction of the Tarbela dam. It was designed to produce electricity as well as to irrigate land and it was necessary to estimate the benefits that the electricity would confer. One way of doing this was to estimate the saving that would be made by using hydro-power instead of natural gas or imported fuel, for electricity generation. This meant that an appropriate set of prices had to be estimated for Pakistan's supply of natural gas. The way in which this was done was, to say the least, unusual. The relevant passage justifying the approach adopted is as follows:

> Currently, West Pakistan is devoting about 3 per cent of available foreign exchange to fuel imports. Given the overall balance between supply and demand, it seemed appropriate to value this foreign exchange expenditure at twice the official rate. As long as fuel imports remain within 3 per cent of total imports, the doubled rate could continue to be used on the assumption that it represents some optimality of allocation. But fuel imports in excess of the 3 per cent level would affect the general scarcity level of foreign exchange, and so such imports would have to be valued at a higher rate. And to complete the argument, once natural gas reserves are exhausted, fuel imports to replace gas used for power will, in fact, be additional imports—i.e. beyond the assumed 3 per cent level. It was estimated that additional imports might double the present level. Thus, on the basis of this relatively crude approach, the Study Group concluded that it would be reasonable to use a foreign exchange rate in these particular calculations of double the current shadow rate used

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> elsewhere: i.e. the rate used....was four times the official rate. Such adjustments can have important consequences as will be made clear in this volume. [1, Vol. III, p. 15]

The argument is elaborated later in the Volume. The reserves of natural gas are limited and will run out eventually, probably between 1991 and 1996, depending on the rate at which they are used; then additional imports will be needed.

> The effect of the need for additional fuel imports can be assessed, for purposes of illustration, on the assumption of unity price elasticity of demand for import goods. Suppose that the requirement for imported fuel increases by 33 percent from 3 percent of total foreign imports to 4 percent. Then imports demanded at the old foreign exchange price would be one percent more than the total foreign exchange available; the scarcity value of foreign exchange would rise one percent and marginal imports in all sectors would diminish.
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> Thus, the result of the greatly increased need for fuel imports would be not only to increase the amount of foreign exchange that must be allocated to cover these imports but, *pari passu*, to cause an upward shift in the effective exchange rate—indicating the effect of the increased foreign exchange stringency on all foreign-exchange-using sectors... The cost to the other sectors in terms of increased rupee prices of imports would be approximately equal to the value of the additional amount of foreign exchange that had to be allotted to cover the increase in fuel imports. Thus the foreign exchange rate which would appear reasonable for purposes of this analysis, would be twice the current scarcity rate or in other words, twice the rate on fuel imports within the 3 percent level. [1, Vol. III, p. 153]

Intuitively, this argument is hard to swallow; it is difficult to believe that an increase in imports by 3 percent would give rise to a devaluation of the currency by 100 percent. A 3 percent depreciation in the exchange rate should be sufficient if the elasticity of demand is unity. In fact it is probably more likely to be true that the elasticity of demand for imports is greater than unity, a figure of 3, 4 or even 5 might be more realistic in many cases, and this might apply to Pakistan as the economy becomes more diversified. But this is not crucial to the argument nor is the argument confined to an increase in fuel imports. Presumably any measures to cut imports by 3 percent would make it possible to halve the rate of exchange, following the line of argument used above.

It is true that a devaluation of 3 percent will cost importers as much as the previous cost of fuel imports in domestic currency; but it will also benefit exporters in domestic currency to the same extent in the case in which exports and imports are in balance and exports do not increase. Exports cannot be left out of the picture.

If it were decided to increase exports rather than reduce imports, the elasticity of demand for the latter would also be relevant to the pricing policy to be followed. If the demand for Pakistan's exports were rather inelastic, price might have to be reduced rather considerably. But here again it seems

unrealistic to suppose that the demand for Pakistan's exports would be other than elastic. About half the exports of Pakistan at the time the calculations were made consisted of raw materials and cotton yarns and fabrics for which the demand is likely to be highly elastic; the demand for exported foodstuffs, particularly rice, and for manufactured exports must also have been quite elastic.

The assumed exhaustion of gas reserves in the future affects other aspects of the cost-benefit calculations. The value of the gas is determined in the analytical framework used in the study by the cost of purchasing alternative sources of fuel when the gas is exhausted. The price of these was determined by reference to the cost of importing oil in dollars converted to rupees at a rate of exchange four times the official rate ruling at the time the cost-benefit calculations were being made, for the reasons discussed above. Using the cost of importing oil to replace natural gas at the time when natural reserves are exhausted, it is possible to establish the price of gas at that time on the basis of thermal equivalents. The price of gas in earlier years can then be established by a process of discounting. Not surprisingly, the results appear a little strange, as may be judged from the following table extracted from the study. In order to compress the table figures are given for 1966 and thereafter at 5-yearly intervals until 1993 when it is assumed that the gas is exhausted.

Economic Price of Natural Gas

	(Cents)		(Cents)
1966	8.1	1980	28.5
1970	11.3	1985	45.3
1975	18.0	1990	77.6
		1993	114.0

Note: Assumed gas reserves 7,300 trillion BTHU and that Tarbela would be completed in 1975; discount rate 8 percent. [1, Volume III, p. 155].

The figures derived are, of course, for economic not market cost. When the calculations were made the price of fuel oil in Karachi was about 30 cents per million BTHU although the economic price of natural gas was costed at 8 cents per BTHU. At that time there was no clear expectation of a large increase in the international price of oil and it is difficult to accept that the rise in price from 8 cents in 1966 to 114 cents in 1993 was a real measure of changing economic cost.

Discussion of the theoretical basis for the valuation of the gas and the determination of shadow exchange rates would be no more than an academic exercise if it were not for the fact that we are told in the study that the price for gas was critical in the assessment of the benefits to be derived from Tarbela, and that the benefits were sensitive to changes in fuel prices. Thus if, as we suppose, the logic of the procedure adopted to calculate the price of gas is unsound, it might be suspected that the effect was to exaggerate the benefit expected to be derived from the construction of Tarbela, and it is possible that it might not have been constructed if other methods of calculation had been employed. No figures of the details of the costs and benefits finally arrived at

have been published and it may be that the price taken for the value of the gas was at that time of less importance than the study claims. Power benefits probably amounted to one-fifth to one quarter of total benefits. Thus in effect the assumption about the price of gas may have been of subsidiary importance in relation to the other major uncertainties involved.

Ironically, the assumptions made about the appropriate price to adopt for the price of gas may not have worked out too badly. If our view is correct, the adoption of dubious methods of valuation in the analysis resulted in a higher price being put on the gas than was warranted. But the price of oil rose threefold in 1973 and it is reasonable to assume that this will have greatly enhanced the value of natural gas reserves and the price that should be put on the gas extracted from them.

The above considerations are bound to bring into question whether cost benefit analysis of the complexity and detail of that conducted for Tarbela are worthwhile given the many quite unpredictable events that may occur during the lifetime (or even the first few years) of a dam. It is not really matters of detail that should be allowed to decide such issues, but analysis and judgements about major political and technical as well as economic issues: a politically prompted major rise in the price of oil has made nonsense of many previous energy calculations. Would the Roseires dam in the Sudan have been built, it may be wondered, if the significance of the construction of the Aswan dam for the storage of the Nile waters had been fully appreciated.[1] The blocking of the outlets of the Tarbela dam in 1974 nearly wrecked the whole structure and might have led to inundation over a large area of Pakistan.

Calculations of the cost/benefits of major investment projects such as dams may be an inescapable part of the decision taking process; but it seems that in many cases refinements in analytical methods and calculations will be dwarfed by the major uncertainties that often cannot be resolved and may indeed be unknowable.

Reference

1. Lieftinch, Pieter, A. Robert Sadove and Thomas C. Creyhe. *Water and Power Resources of West Pakistan.* Baltimore (Md., USA): The Johns Hopkins University Press. 1969. [A World Bank Study; several volumes.]

[1]The amount of water that the Sudan was entitled to draw directly from the flow of the Blue Nile during the season of low water was restricted by agreement with Egypt. By making possible the storage of water during the period of high flow the Roseires dam could be used to increase the use of water during the period of low flow without affecting the availability of water to Egypt at that period of year. But the storage capacity of the Aswan dam is so great that there is no need to restrict the Sudan's use of water at any particular time provided that no more water is drawn for the year as a whole than the total share to which it is entitled. As a result one of the major reasons for constructing the Roseires dam has disappeared.