POLICY MODELLING OF THE OIL AND

GAS SECTOR IN INDIA

Abstract

by

Raghavendra D. Rao

The dissertation analyzes the various policy issues relating to the oil and gas sector in India. To begin with, various phases in consumption of petroleum products in India from the year 1960 through 1996 is analyzed with the help of analytical instruments to capture the changes in the pattern of consumption. The growth in consumption of petroleum products has been steep with a compounded annual rate of growth (CAR G) of 5% during the last twenty five years, with the CARG being a reduced 2.7 percent in the early nineties due to slowing down of the industrial activity .

Demand forecasts of petroleum products form a crucial input for planners and policy makers. Econometric models have been developed separately for the various petroleum products with an aim to capture variables which are specific to the individual fuel. A non-homothetic TRANSLOG functional form has been specified while developing the demand models. To check the effectiveness and accuracy of the models obtained, the models have been evaluated for *ex-post* forecast accuracy for a specified time period. The demand for motor gasoline, HSD, kerosene, LPG and A TF is expected to grow at a very rapid rate during the forecast period while that of fuel oils, LDO, naphtha and lube oils is expected to grow at a relatively lower rate.

In the literature, progress in the modelling of exploration and extraction activities have been moving in parallel. With an aim to unify the two streams in an integrated framework, an integrated dynamic optimization model with non-linear constraints has been conceptualized. This model combines a practical methodology to determine optimal rate of extraction of oil and gas with a hybrid approach to estimate the discovery rate of petroleum resources in future, additionally incorporating stochastic specification in order to capture the uncertainty associated with discovery.

Further, the conceptual framework established is adapted and applied to the Indian oil and Gas sector. Various issues pertaining to the exploitation of petroleum resources in India are analyzed by the model PETEX, to provide the policy maker with a *"choice-set"* to arrive at the

most desirable set of joint decisions comprising investment decisions for exploratory and development drilling, production decisions for the various producing reservoirs and decisions regarding imports. The results underline the acute need of augmenting investments into the upstream activities without which, the dependence on imports to meet the domestic demand would be on the rise with the demand-supply gap rapidly widening over the years.

Further, the model PETEX is expanded to capture further downstream activities of petroleum supply viz. refining of crude oil. Since this model- IPSM - builds upon the model PETEX by additionally incorporating the refining aspects, new insights are obtained through integrated analysis of the upstream and downstream aspects of petroleum supply. The output of this model includes the expected magnitudes of crude oil and natural gas discovered in the various basin aggregations, the recoverable reserve positions for crude oil and gas, the production path of crude oil and gas, production of various model petroleum products from the various refineries across time, import requirement of crude oil to meet the domestic refining requirements and their cost, import requirement of the various petroleum products to meet the demand and their cost, and investment requirements for exploration and development activity and for capacity expansion of refining. The emphasis of this analysis is on the downstream sector. The model results suggest that constraints on investments towards upstream activity would   act as a bottleneck for growth in the downstream sector, given the higher costs involved in crude oil imports which would be required as throughput for the refineries. The model weighs the option of import of crude oil, setting up of new refining capacity and producing indigenously as against import of petroleum products. The output suggests a moderate increase in refining capacity addition given the high cost of crude oil import required as throughput for refining. Given the crude oil production scenario, the model finds it optimal to increase petroleum products import as compared to importing crude oil and setting up new refining capacity. The results also indicate that in the short to medium term, it would be very difficult to alleviate the problem of domestic crude oil availability. Hence, only a sustained increase in investment towards upstream activities in the long term could possibly make a substantial difference in terms of bridging the ever increasing demand-supply gap. Thus, unless the crude oil imports are available at competitive rates, it would be inviable for investors to establish additional refining capacities in the near future.