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Petrochemicals

Since 1969, IFC has helped finance \$5 billion of petrochemical investments (defined here as olefins, aromatics, and their derivatives) through 27 ventures in 9 developing countries, mainly in Latin America and Asia. A recent study of a sample of 11 of the ventures by IFC's Operations Evaluation Group (OEG) confirmed IFC's generally good experience with these ventures. IFC has fared well as a lender and equity investor, and many of the ventures have become highly efficient producers by international standards, providing convincing proof that petrochemical know-how can be effectively transferred to developing countries.

Several ventures have developed the capability to make significant process improvements, expand capacity at low cost by removing bottlenecks, or design and carry out major expansion projects. Although the ventures themselves did not create many jobs, they have had a catalytic effect on downstream industries (which are traditionally more labor intensive), as well as support enterprises engaged in plant design, engineering and fabrication, and have contributed to the pool of well-trained, experienced managers and technicians, many of whom later moved to other local firms. The OEG study devoted particular attention to markets, technology, cost competitiveness, and government assistance.

Markets

Virtually all the ventures faced highly competitive markets. Although roughly half had planned to export part of their output (either directly or by selling to export-oriented downstream customers), nearly all had to export significant volumes. Domestic consumption fell short of expectations in most of the Latin American ventures due to erratic economic conditions. Domestic production exceeded expectations because obsolete facilities were not retired as expected, existing producers were able to expand output significantly by eliminating production bottlenecks, and new plants were built. Imports exceeded expectations because cyclical imbalances led producers in other countries to price products aggressively, preferential duty arrangements provided market access to suppliers in neighboring countries, and, ultimately, tariff levels fell. The combination of these factors resulted in actual margins over feedstock costs falling significantly short of projections in 70 percent of the companies reviewed.

Technology

None of the ventures that used commercially proven processes had major technological problems. In contrast, two ventures using technology that had been tested only in pilot plants have been unable to produce at rated capacity. They were plagued by process scale-up problems and design flaws, and one of them now considers that, given the untested nature of the process, the design was too tight and should have included allowances for capacity and yield shortfalls.

Five factors contributed to the successful absorption of the necessary technologies in the other companies:

- All the host countries had well-educated engineers and technicians, many with experience in petrochemicals or petroleum refining.
- All of the companies formed project execution teams with engineering, marketing, and financial experience at the project preparation stage. The teams actively participated in project planning and implementation and, in the process, gained valuable training and

know-how. The process helped foster loyalty and many of the core personnel now hold senior positions in the companies.

- In nearly all cases, the know-how suppliers-whether shareholders or not-participated in management or provided extended technical assistance well beyond the start-up period. Careful selection of know-how suppliers and local staff to work with them and good working relationships between the two sides contributed to favorable results.
- All the ventures arranged for their know-how suppliers to provide training. In addition, some benefited from training programs arranged by upstream petrochemical plants, local universities or training institutes, and one effectively used a training simulator purchased with the plant.
- Although most of the ventures made efforts to keep abreast of developments in technology and management, the better-managed ones gave greater emphasis to these efforts. Many have met regularly with their process licensors to exchange information on technological developments.

Cost Competitiveness

The successful ventures were generally able to produce at internationally competitive costs. Most benefited from low capital costs per unit of output and good conversion efficiencies, and some benefited, at least during their early years, from attractive feedstock prices.

Unit Capital Costs

Most of the ventures installed low-cost capacity at the outset, and all were large enough to gain from economies of scale. All the successful companies had excellent in-house project management teams, and most were able to cut costs by using local firms for detailed project design and engineering. Two of the eleven companies benefited from particularly low equipment prices during a recession in the international chemical equipment market, and two from low prices on domestic procurement. Several ventures further reduced unit capital costs by removing production bottlenecks or undertaking major expansion projects, enabling them to upgrade their facilities to use the latest cost-saving technologies.

Good Conversion Efficiency

Since direct materials-including primary feedstocks, catalysts, and other chemicals-typically account for 55-75 percent of the total costs of petrochemical plants (including capital charges), producers seek to minimize consumption of these materials. Computerized control systems have become virtually indispensable, but operating experience and familiarity with the processes involved are still crucial in optimizing performance and squeezing out extra yields. Most of the ventures reviewed made use of external expertise, particularly in their early years, and achieved good conversion efficiencies. One of the ventures did not and failed to achieve the target efficiencies until its fifth year.

Feedstock Prices

Several of the ventures had the advantage of attractive feedstock prices, at least in the initial years, but by the time of the evaluation most had to pay international prices or, based on long-term contractual arrangements, prices even above international levels. Changing market conditions have often undermined long-term contracts that imposed a heavy burden on one of the parties.

Government Role

Advantages

All of the plants reviewed were built in the context of government programs to develop petrochemical industries, and all gained from some form of governmental support:

- **Infrastructure.** All but two of the projects were integrated into government-promoted petrochemical complexes where substantial infrastructure was available. These facilities, especially those for utility and feedstock supplies and central effluent treatment, greatly reduced the riskiness of the projects and facilitated their structuring and financing.

- Attractive feedstock pricing. Several of the ventures benefited from attractive feedstock prices in their early years. Due to economic liberalization and other developments, these incentives were withdrawn in the late 1980s.
- Export incentives. Some of the Latin American ventures were also aided by export incentives, but these arrangements declined in importance in recent years.
- Tariff protection. All of the ventures have benefited from tariff protection (and, in the case of some Latin American ventures, foreign exchange controls that have restricted imports), but competition from other domestic suppliers and from imports have limited their ability to take full advantage of this protection. Moreover, in line with the broad movement towards lower trade barriers, all but one of the host countries have reduced the tariff levels to the range of 10-20 percent within eight years.
- Financing. The host governments facilitated the mobilization of financing for most of the projects through some combination of direct loans, loan guarantees, and equity investments from domestic institutions.

Government support, intended to launch and then nurture the industry, appears to have succeeded for at least six of the projects reviewed, which have developed into highly efficient, internationally competitive producers. In these cases—as well as the other, more problematic ones—IFC satisfied itself at the outset that the companies were not likely to depend on this support for their profitability. (See box.)

Drawbacks

Government assistance, however, was clearly not justified in one venture, the survival of which is in doubt, and may or may not have been justified in four other cases. Moreover, government intervention has had undesirable consequences on international competitiveness in several cases:

- Two countries sought to foster competition by using licensing procedures to encourage multiple producers. Although individual plants still gained from some economies of scale, the policy limited the industry's ability to take full advantage of potential scale economies and limited its ability to engage in research and development. These countries could have encouraged competition more effectively by lowering tariff barriers.

In accordance with IFC policies, the investment decisions in the ventures reviewed were based on expectations that the ventures would meet adequate standards of efficiency as measured, *inter alia*, by the economic rate of return. The economic rate of return is calculated by adjusting for the effects of distortions on market prices and valuing project costs and benefits at the opportunity costs to the economy. Financial profitability is a prerequisite for IFC's going forward with an investment but is not in itself an adequate indicator of a project's efficiency. IFC policies call for IFC not to invest in projects that are expected to be dependent on subsidies or protection for their financial viability.

- In some countries, the high prices resulting from protection in earlier years inhibited consumption and the development of downstream, export-oriented conversion industries. The consequences of high protection were clearly demonstrated by the experience of a multinational firm that had invested in three similar petrochemical plants in the early 1980s. Over the ensuing ten years, it expanded production three to nine times in two low tariff countries but only sixty percent in a high tariff country.
- In one case, high profitability, derived from feedstock discounts and export incentives, masked production inefficiencies that should have been addressed at an early stage.

Clearly, government interventions were successful in some cases but not in others. The results of a sample of eleven petrochemical projects in five relatively advanced developing countries do not provide an adequate basis for any general conclusions about the wisdom of selective government interventions to assist particular industries. The efficacy and efficiency of these interventions in an increasingly liberal world economy remain an open question.

