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Chapter 15

Investment, Innovation and Growth

Among the significant, but relatively intractable, issues in the study of QR-regimes is whether they have any discernible impact on the inducement to invest and the inducement to innovate.

The former question is of interest, because some LDCs presumably are in a position where the emergence of an adequate number of entrepreneurs to exploit economic opportunities is a prerequisite for industrialization. Hence if we can argue that QRs provide the economic framework needed to induce investment, that should be considered a merit of the QR-regime. On the other hand, we must also ask whether such inducement, if needed, could not also be provided by alternative policies; and whether such an alternative set of policies would not have resulted in a more efficient pattern of investments.

Closely linked to this is the question of the inducement to innovate. Efficiency in the pattern of investments is only one aspect of the problem. The quality of entrepreneurship and the inducement to innovate are recognized by economic historians and by economists estimating the role of technical progress in growth to be of at least equal importance. Can we then relate the QR-regime to these aspects of the economy as well?

These are interesting, important and difficult questions. In what follows, we attempt to answer them in light of the Indian experience, warning the reader that we are on relatively treacherous ground even as economic analysis goes.

INDUCEMENT TO INVEST

The notion that India lacked an adequate supply of entrepreneurship and that a system of automatic protection conferred by the QR-regime was necessary to induce investment is impossible to reconcile with the facts of Indian history up to the time that planning began in the 1950s.

The tradition of entrepreneurship in India has long been documented by economic historians.[1] Furthermore, this historic supply of entrepreneurship was not merely for trade but also for industry. In fact, the industrialization of India started in the nineteenth century and proceeded with moderate, and even negligible, tariffs during the first part of the twentieth century.[2] Furthermore, the leading industrial entrepreneurship tended to be economically rational and even "progressive." Thus, Jamshedji Tata, who set up in 1913 the first successful Indian steel mill, came from a background and fortune in cotton trade; and he built up an efficient and stable industrial force which was critical to performance in a steel mill. And Morris D. Morris has shown clearly how, in the cotton textile industry, where a stable and disciplined labor force was *not* critical to performance, the entrepreneurs were willing to accommodate quite different labor practices rather than invest time and money in changing them.[3] In Tata's case, the entrepreneurial activity even extended to setting up, from the beginning, a school to train Indian technicians to take over from the foreign personnel at the earliest!

It would appear to us, therefore, that in the Indian context it is not persuasive to argue that a QR-regime, with its automatic protection for indigenously produced items, was necessary to induce industrial investment. Furthermore, in the Indian case, the public sector has been an important investor in industry, thus weakening still further the argument for a QR-regime to provide automatic and indiscriminate protection to induce investment.

There is therefore nothing in the Indian experience to suggest that India could not have sustained the desired *ex-ante* levels of investment in industry by using a suitable tariff policy, the standard instruments of monetary and fiscal policy and her public-sector investment programs.[4]

INDUCEMENT TO INNOVATE

In point of fact, the QR-regime, as we have already noted in Chapter 13, only served to influence and, in conjunction with the industrial licensing machinery, to determine a pattern of import substitution that certainly appears to have been relatively chaotic and unmindful of economic costs. Did it also influence adversely (1) attention to quality and (2) technical progress? There is also the related question: does an export orientation produce better results in both these directions?

Adverse Effects.

1. Unfortunately, no meaningful statistical index of "quality" can be devised. On the other hand, it is manifest that in a regime which grossly reduces competition (as we have argued) and creates a captive market for many products thanks to the doctrine of indigenous availability, it would be "rational" and profitable for an entrepreneur not to pay attention to the quality of production. Thus, it is only the "quality-minded" entrepreneurs (like Tata, Mahindra and Mahindra, and Kirloskars, to take the most noted exceptions) who are known to produce products that approximate international standards of performance for similar products. For the rest, the effects of the economic regime appear to be evident, though impossible to quantify: products with faulty performance because of production defects or defects in the inputs of domestic manufacture. Even when one has allowed for the bias in evaluation arising from the fact that, in V. S. Naipaul's words, there is "a craze for foreign," there is so much general incidence of failure to improve quality of performance to satisfactory levels, and this is so precisely what one would expect as the result of the economic regime, that it seems fair to conclude that the regime has indeed aided in bringing about these adverse results.

2. Closely related to the failure of producers (even in the organized sector) to raise their output to satisfactory levels of performance, but shading into the problem of innovation which we discuss later, is the well-documented phenomenon of "design deficiencies," which Mark Frankena has studied in some depth for the engineering goods industry during the 1960s.

Frankena carefully explains that he is not discussing design deficiencies in the sense that Indian producers do not produce to the "latest," capital-intensive and automated designs, but rather that, even for designs that sell in the LDCs of Africa and Asia, the Indian are uncompetitive and "unpreferred" *vis-à-vis* those of rival producers. He also generally confines himself to examples that indicate that Indian designs are fully dominated by other designs, no matter what the shadow or actual prices of the factors of production. We must enter the *caveat,* however, that, while these examples establish a *prima facie* case that the Indian policy environment has produced incentives for a lag in adaptation to more efficient designs, they do not constitute a clear verdict to that effect. It is conceivable that the cost of buying or imitating these superior designs may outweigh the gains from their adoption, both privately and socially; only if the new designs were available without cost would these examples be, in themselves, complete proof of our contention. But the examples do remain strongly suggestive and supportive of our thesis. Let us therefore quote a few of the more telling ones.

For electric motors and transformers, Frankena notes that the Indian Tariff Commission Report of 1966 stated that:

> Indian motors were larger and much heavier than motors of the same horsepower manufactured abroad and that the excess weight was considered undesirable by users. It also estimated that adoption of foreign specifications would result in a reduction of 20 to 33 percent in material costs. The following differences in design and material specifications were noted: (i) foreign motors used aluminum die-cast rotors instead of rotors with copper strips; (ii) foreign motors used aluminum die-cast bodies instead of cast iron bodies, which resulted in a reduction of weight; (iii) foreign motors had class "E" insulation, which resulted in lower inputs of copper and electrical steel stampings than were required with the class "A" insulation used in India. In addition, class "E" insulation enabled motors to withstand higher temperatures.
>
> In the second half of the 1960's a number of Indian manufacturers adopted these design changes for part of their production. Nevertheless, in 1970 the Indian Electrical Manufacturers' Association reported that of 32 manufacturers in the organized sector and 170 in the small scale sector, only twelve produced motors with class "E" insulation.[5]

Again, with distribution transformers, the Indian manufacturers were continuing to use hot rolled sheets rather than cold rolled grain oriented sheets, with resultant energy losses up to 10 percent and an incremental cost in steel and copper of nearly 10 to 25 percent.

Among other examples of product-design improvement foregone, Frankena notes cotton textile machinery. The 1967 Tariff Commission Report mentioned ring frames abroad that incorporated several improved features enabling them to run at speeds up to 16,000 RPM without mechanical trouble whereas the Indian designs could not be taken beyond 12,000 RPM: "even at lower speeds the yarn breakages are sometimes heavy with consequent deterioration in the quality and evenness of yarn . . . there has been improvement in the quality of indigenous cotton textile machinery after 1963, but . . . the domestic products still lack proper designing, casting, standardisation and finishing. . . ."[6]

These examples relate to designs that appear to have been economically dominant over the ones still in vogue in India—in terms of the productivity of the output in user industry and/or the material cost of unit output itself.[7]

At the same time, problems of lagging designs were to be found in *consumer goods* industries as well: e.g., on electric fans Frankena quotes an Engineering Export Promotion Council Report on a 1959 exhibition in Singapore:

> Our (Indian) "Usha" and "Orient" table fans lacked the lustrous finish which was eye-catching in the case of (Japanese and Hong Kong) "Hulda" and KDK fans. If the revolving device and the finish of our table fans are improved, I see no reason why the sales should not improve. In the export

> market, it is imperative that we should catch up with the latest design and construction of the Japanese fans.

and goes on to comment that:

> A decade later Indian table fans were still out-dated and inferior in design, styling, and finish to fans exported by Japan and Hong Kong to developing countries. Japanese and Hong Kong fans had smoothly finished and bright-colored stands and plastic casings in modern shapes, nickel-chromium-plated fittings and protective mesh, and gadgets like time switches, variable oscillation-angle controls, and plastic piano-style keys for different speeds. The exteriors of Indian table fans were made of painted cast iron and steel, the fans were heavy, the styling, surface finish, and colors were not attractive, and there were no controls other than choice of speeds. Late in the 1960's, Jay Engineering introduced one model with variable oscillation control and piano-style keys but none of the other styling features. Indian fans were also noisier than Japanese ones.[8]

3. Next, we should also expect that the lack of competition in the Indian-type economic regime raises the possibility that firms may choose "leisure" rather than "profits."[9] If this takes the form of being simply sloppy about reducing costs and increasing productivity from the plant by better management, this is equivalent to "technical regress" and to social disadvantage. Unfortunately there is no technique by which we could have meaningfully detected this effect of the QR- and industrial licensing regime, and we must leave this purely as an *a priori* deduction.

4. We may also attempt to examine whether an estimation of technical progress for the Indian manufacturing sector shows any evidence of increase in productivity. We may hypothesize that the result of a framework of sheltered markets would be the absence of any noticeable trend toward growth in productivity.[10]

We should note initially that labor productivity did increase through the period of our study. Estimates by Banerjee[11] of the growth of labor productivity for 1946–64 are presented in Table 15–1. However, it is now clearly understood that such estimates have little relationship to growth of overall productivity, and that the superior approach is to proceed by estimating production functions and "technical change" therewith.

Recent studies of the growth of manufacturing in India have, however, come to conflicting conclusions on this issue, depending primarily on the nature of the adjustments made in the available series on capital. Using the Solow method of estimating Hicks-neutral technical change, but a capital series that shows a drastic decline in capital productivity from 100.00 in 1946 to 25.4 in 1964, Banerjee has estimated a trend rate of *decline* in neutral technical change of 1.6 percent in 1946–64.[12]

TABLE 15–1
Indices of Labor Productivity in Indian Manufacturing, 1946–64

Year	Indices of Labor Productivity 1946–64	Year	Indices of Labor Productivity 1946–64
1946	100.0	1956	123.6
1947	94.9	1957	120.7
1948	98.7	1958	133.0
1949	96.6	1959	139.1
1950	91.8	1960	140.0
1951	97.7	1961	140.2
1952	96.1	1962	156.0
1953	107.8	1963	151.0
1954	107.8	1964	164.0
1955	134.3		
Trend rates of growth 1946–64	.033 (.0002)		

SOURCE: A. Banerjee, "Productivity Growth," Table 1.

On the other hand, Hashim and Dadi have used an adjusted capital series, estimating the purchase value of capital from the available written-down book-value data by more detailed and careful methods of adjusting for the age-structure of capital assets and rate of depreciation. Their estimates show an *increase* in capital productivity over the period 1946–64 and lead to a positive Hicks-neutral, overall productivity change at 2.8 percent annually.[13]

Quite aside from their adjusted capital estimates, it would appear to us that the Hashim-Dadi estimates are probably closer to reality because our hypothesis of the Indian sheltered-markets policy leading to negligible overall improvements in efficiency of factor use must at the same time allow for the fact that new investments in the new industries already embody the growth of know-how abroad. The estimation of (Hicks-neutral) technical progress, using the "disembodied" progress assumption, will thus tend to show positive, and even large, improvements in overall productivity even when there are no such improvements. Unless, therefore, the estimation of productivity change is adjusted for "embodied" technical change—a factor of obvious importance for India which imported the bulk of its capital goods through the period of our study—we cannot reach a firm econometric conclusion on whether the framework of Indian policies retarded the growth of overall productivity in the economy.[14]

Other Arguments.

There is therefore some *a priori* and empirical support, of different degrees of firmness, for the view that the Indian trade regime *in toto* led to, or accentuated, the lack of attention to quality, design and technical change. We may now push our analysis in other directions that bear on these issues equally.

1. If one considers change in overall productivity as the outcome of technical change (inclusive of managerial efficiency), and if one regards the degree of domestic sheltering through the import substitution strategy as the principal cause of decelerated technical change, then one should presumably expect the following two hypotheses to hold empirically:

(a) that the traditional, export industries (such as jute and tea) should exhibit higher technical change than the modern, new industries (such as chemicals and engineering goods); and

(b) that among the new industries, furthermore, the ones that have broken out more significantly into the export markets and over a longer period should also exhibit greater rates of technical change than the others.

These hypotheses imply cross-sectional differences, however, which may well be difficult to detect because of other differences among the industries that differentially affect the ability to invent and absorb technical change. For example, it may well be that, owing to the focus of research and development expenditures on modern industries in the West, the general rate of technical improvements that accrue in the new industries is vastly greater than that in the older industries such as jute and tea where the large Western expenditures on research and development have no impact at all. Hence our failure to find significant increases in overall productivity in the traditional industries may *not* mean that export orientation may not be an important factor in motivating technical change.[15] Similarly, the period during which several industries in India have been involved in serious export marketing may have been too small for any serious inferences from cross-sectional differences among the different new industries.

We should confess that we have not been able to secure the necessary estimates of technical change in enough industries, for the relevant time period, to cast any definitive light on the validity and import of the two hypotheses we have listed here. But they clearly are of sufficient importance to warrant a careful examination as more years lapse and data become available for a longer period to make time-series estimation meaningful (particularly with regard to our second hypothesis).

2. Yet another approach to the relationship of import substitution and export orientation to technical change is to examine the nature and incidence of research and development in Indian industries. We must note, in this con-

nection, the increasing evidence that research and development expenditures are finally beginning to emerge on the Indian scene, in a number of import-competing industries, that such expenditure is being undertaken by the very large firms, and that it is undertaken in the process of import substitution itself and reflects a quasi-Kennedy-Weizsacker process of search for processes that would avoid the use of scarce, imported materials and develop the use of cheaper, indigenous inputs. Of course, as stated earlier, this research and development activity may be expensive in relation to results: but it is certainly there now and is adding to the technological maturity and expertise that the country seeks as an objective in itself. Historically, one has only to recall Japan's transition from shoddy manufacture under bad imitation to decent manufacture under good imitation to excellent manufacture under outstanding imitation to innovative manufacture in recent years. In such a historical perspective, it would appear logical to entertain the strong possibility that at least *some* of the inadequacies noted earlier may be due to the difficulties of "first-stage" manufacture in a number of modern industries and that the growth of research and development in recent years may represent a growing transition to decent manufacture. What *is* the evidence of research and development in modern Indian industry?

Before we discuss research and development expenditure in Indian manufacturing industry, it is useful to note that the *total* as a proportion of GNP has been steadily rising, having more than doubled between 1958–59 and 1971–72 (Table 15–2); and that the private sector expenditure on research and development, while still a small fraction of the total, has increased during the same period so that it is now over 8 percent of the total whereas in 1958–59 it was estimated at 0.5 percent only (Table 15–3).[16]

There is also evidence that the bulk of this private research and development expenditure is inevitably concentrated in the larger companies, and that the level of expenditure generally rises with the size of the company.[17] Among the propositions of interest to our study, however, are the following which were the outcome of a sample survey conducted by Dr. Ashok Desai at our suggestion. Before we report on them, we should emphasize that the survey was primarily focused on chemical and dye (and a few engineering) firms in the Bombay region, owing to limitations of finance and willingness of firms to discuss the issues raised. Of the 18 firms interviewed, 4 were subsidiaries of foreign corporations, and of the remaining 14, 6 did not belong to the Large Industrial Houses. Further, of the 14 Indian firms, only 4 were joint ventures and the remaining were purely Indian in ownership. Thus, our sample managed to straddle all the important types of structure operating in Indian industry. Based on this survey[18] and drawing on the available literature on research and development in India, we can make the following qualitative observations which seem to suggest two principal conclusions: (a) that the

TABLE 15-2

R&D Expenditure in India in Relation to GNP, 1958–59 and 1965–66 to 1971–72

	1958–59	1965–66	1968–69	1969–70	1970–71[a]	1971–72[a]
(a) Total GNP at current prices (Rs. millions)	126,000[b]	217,990	302,320	330,190	363,210	399,530
(b) R&D expenditure (Rs. millions)	290	850	1,310	1,460	1,730	2,140
(c) R&D expenditure as % of GNP	0.23	0.39	0.44	0.44	0.48	0.54

SOURCES: *Report on Science and Technology*, 1969–70 and 1970–71, Government of India, Cabinet Secretariat, Committee on Science and Technology, New Delhi.

The GNP figure for 1969–70 has been obtained from Government of India, Department of Statistics, Central Statistical Organisation, National Income Unit, New Delhi. Similar figures for subsequent years are not available. The Planning Commission has envisaged growth of national income during the Fourth Plan period at 5.5 percent at constant prices. There was an average rise of about 6 percent in general wholesale prices during 1970–71, and the trend continued through the following year. Therefore, GNP for 1970–71 and 1971–72 is tentatively projected in this table at a 10 percent rate of growth.

a. Tentative, projected by the authors.

b. NNP

TABLE 15-3

Estimated R&D Expenditure in Central, State and Private Sectors, 1958–59 and 1965–66 to 1971–72

(Rs. millions)

	1958–59		1965–66		1968–69		1969–70		1970–71		1971–72	
	Expen-diture	% to total	Expen-diture	% to total	Expen-diture	% to total	Expen-diture[a] (Actual)	% to total	Expen-diture[b]	% to total	Expen-diture[b]	% to total
(a) Central sector (including universities)	276.6	96.0	791.2	93.0	1,096.0	83.4	1,212.6	82.9	1,462.0	84.3	1,827.4	85.4
(b) State sector	10.0	3.5	35.1	4.1	119.9	9.1	122.2	8.3	125.8	7.3	138.4	6.5
(c) Private sector	1.5	0.5	24.3	2.9	98.5	7.5	128.1	8.8	145.9	8.4	174.6	8.1
TOTAL	288.1	100.0	850.6	100.0	1,314.4	100.0	1,462.9	100.0	1,733.7	100.0	2,140.4	100.0

SOURCES: *Report on Science and Technology,* 1969–70 and 1970–71, Government of India, Cabinet Secretariat, Committee on Science and Technology, New Delhi.

Adequate data for the State Sector have not been received. Therefore, figures for 1969–70 and 1970–71 have been repeated from *Annual Report on Science and Technology,* 1969–70. Figures for 1971–72 have been projected at a 10 percent rate of growth.

Increase in the expenditure by the private sector reflects receipt of information from some more companies. Where data for 1970–71 and 1971–72 has not been received, a 10 percent growth rate has been applied. Expenditure by the private sector also includes grants made by the CSIR Industrial Research Associations out of their own resources and included under CSIR expenditure.

a. Reduction in the expenditure for 1969–70 by the Central Sector reflects reduction in actual as compared with revised estimates as given in *Annual Report on Science and Technology,* 1969–70.

b. Tentative, projected by the authors.

import substitution strategy does *not* eliminate the incentive to conduct research and development but merely imparts a bias toward conducting it in a different direction, so that the really important question then is not whether it is eliminated by the import substitution strategy but rather whether the kind induced by such a strategy reduces or increases welfare in relation to the research and development that would otherwise be conducted; and (b) that orientation toward export markets does not in itself seem to increase the incentive to conduct research and development, so that it is difficult to sustain the argument that an export promotion strategy is superior to an import substitution strategy because it will lead to greater (and presumably welfare-increasing) research and development in the economy. Let us therefore turn to a series of propositions that emerge, somewhat tentatively, from our analysis.

Origins and Types of Research and Development in Indian Industry.

There are basically three types of activity that seem to have provided the impetus in Indian industry to set up research and development cells of one kind or another.

Quality Control

Firms that started with quality checks often found that processing costs could be brought down by checking quality at a number of production stages instead of checking it after final manufacture. Thus, quality control led to process control, and process control often extended into a study of the processes and possibilities of improving them. Thus, one of the engineering firms surveyed by Desai used to check the quality of its castings from early on. During the 1966 recession, it tried to bring down the rejection rate by introducing checks at a number of stages—knockout, fettling, finishing, repairing and machining. It was thereby able to reduce the amount of work done on castings that were eventually rejected, and to bring down the mean fettling and finishing man-hours per ton from 110 to 80.

Technical Services

The demand for some products, mainly chemicals, was not confined to one uniform quality; the quality demanded varied with the use for which it was required. Some tailoring of quality to customers' needs was involved. Hence technical services were associated with sales to develop qualities required by customers. Sometimes the demand for a particular quality demanded by a customer was too small, and the customer had to be persuaded and helped to use a substitute in greater demand. Thus, orders generated their own know-how requirements; and, as orders multiplied, the know-how developed to service them was often systematized into general product know-how and correlated with processes. This emergence of research and development out of servicing needs is typical of PVC compounds, which are sold to large numbers of technologically unsophisticated buyers for a vast variety of uses.

Material Adaptation

Often the policy of blanket import substitution forced firms to use indigenous substitutes; and where the domestic and the imported materials differed in quality, a firm had to work out processes to make the indigenous product useable. In a sense, material adaptation is a technical service to be given by the firm wishing to sell a substitute. But the principle of banning imports of anything that was produced at home relieved producers of the need to provide sales service; and often the indigenous producers were too small to solve technical problems arising in the use of their products. Thus, many chemical firms had to undertake research and development to standardize properties of indigenously available materials and to improve yields achievable with them. For instance, when one of the chemical firms tried to substitute Indian turpentine oil for European, it found that only 25 to 30 percent of the former consisted of alpha-pinene, the basic material for camphor, against 90 percent of imported oil. Thus, import substitution threatened to triple the turpentine requirements per kg. of camphor. Their technicians proceeded to analyze the remaining components of Indian turpentine oil, and developed a number of perfumery materials from delta-3 carene and longifolene, which were present in substantial proportions. Eventually, the market for these newly developed materials grew so large that a surplus of alpha-pinene became available beyond the requirements of camphor manufacture; new materials were then developed for manufacture out of alpha-pinene. A rival firm, on the other hand, solved the same problem by using camphene in place of pinene.

Clearly, the process of import substitution itself led to the encouragement of research and development activity in Indian industry, primarily through the creation of the need to adapt processes to the use of new, indigenous materials in many cases, thus supplementing the normal establishment of research and development-type cells for quality control and customer-service operations. In fact, this kind of impetus was also imparted by strict controls over the importation of plant and equipment; and, in some chemical and engineering industries, this led also to the creation of special plant-designing skills. Some well-known examples were the caustic soda plant expansion by Tata Chemicals from internal designing resources and the designing of the pigment plant by Sudarshan Chemicals.[19]

Of course, in only rare cases did the expansion of research and development activity in India lead to its orientation toward what is called "basic research." In the nature of the case, given the main concern of the firms to learn process and material adaptation, the research and development orientation was to be primarily of the nature of "operational investigations" and "development." Most of the research carried on seemed to be short term and focused on a specific process. For example, at one of the engineering firms surveyed 2,000 motor starters were held up on the production line for lack of silver salt, and the problem was given over to the research and development department. This department then proceeded to investigate what had been used prior to the use of silver salts, whether other firms used other materials for identical purposes, and whether the firm could adopt some alternative suggested by such investigations. The research revealed that the firm could use a compound that had been superceded in starter manufacture in other countries but still seemed to be the most economical substitute to use in India.

Research and Development and Exports.

The next set of propositions that seem to emerge from our survey relates to the interaction of exports with the type and level of research and development expenditure in Indian industry. It did seem to emerge from the survey interviews that several of the companies engaged in exporting as a *continuous* activity did consider that quality improvement was important, whereas those firms that engaged in exporting only as an *ad hoc* activity seemed to think that quality problems were not important and that the better production could be diverted abroad whereas the inferior products could be disposed of in the domestic market. It does seem, therefore, that export orientation did suggest greater preoccupation with quality of production.

On the other hand, the survey also showed that this export orientation did not seem to have led to any significant acceleration in research and development expenditures or to a more sharply focused research effort. This was because most research and development expenditure had in fact originated in response to the problems raised by the adaptation of processes to locally available materials and spares; and the solution to these problems generally meant also the solution to associated problems of quality. Hence, the export orientation of a firm did not seem to lend any significant edge to the solution of these questions. And indeed some firms even claimed that their need to engage in research and development had been reduced by expansion into export markets because they had had to undertake research and development to supply a variety of products to maintain a large sales volume at home whereas concentration on a few, standard items in the export market had reduced their need for research and development.

It also seemed as if many of the exporters were seriously worried about getting materials cheaply and readily rather than about quality of manufacture from these materials. This suggests that, in many cases, the basic research and development problems had really been those of getting familiar with the basic processes and then of adapting them to the use of available materials; and that once these had been solved, in the process of import substitution itself, the fact that the firm had begun exportation did not seem to lend any significant, further impulse to greater research and development activity or its redirection. In fact, this suggests rather strongly that the normal preconception that export orientation may be linked with the enhancement of research and development incentives may be true at a *later* stage of industrialization than that now characterizing countries such as India, Brazil and Mexico, i.e., a stage when exportation of *new products,* resulting from research and development, has become an important ingredient of a country's foreign trade, as is now the case finally with Japan.

Research and Development and Government Policies.

Finally, we must conclude that the *net* effect of government policies on research and development, in the Indian context, also reflects the impact of several other factors: (1) The strict industrial licensing policy meant that, if research and development was used to develop new types of outputs or new uses of given capacity, new licensing would be required, with its attendant delays and new uncertainties whether research and development would lead to any economic returns. Thus, any "excess capacity" for research that would result from the development of research and development cells normally deployed in the ways described earlier could not be profitably used to undertake *product-diversification* research, thus reducing, *ceteris paribus,* the level of research and development expenditure undertaken. (2) The early industrial licensing policy also had laid great stress on joint ventures under which foreign capital would come into India. This also frequently led to easy and repeated purchase of foreign technology, reducing, *ceteris paribus,* the need to undertake domestic research and development. (3) Recently, however, the government was to introduce liberal research and development incentives. Thus by 1971, research and development expenditure within the firm earned a 33.33 percent tax allowance; donations to outside institutions for such research earned a tax allowance of 27.5 percent; and research contract payments to associations, universities, and government agencies could be written off up to 10 percent of a year's corporate profit. There were also tax rebates introduced on sale of know-how: domestic royalties earned a rebate of 40 percent whereas royalties earned from sales of technology abroad were free from tax.

It is somewhat early to disentangle these different forces at work in determining research and development efforts in India. But we have clearly enough evidence now before us to be skeptical of some of the simplistic hypotheses in support of the export promotion strategy as being research and development-stimulating and the import-substitution strategy as being research and development-inhibiting. Nonetheless, we can still argue, as we did earlier in this chapter, that the general incentives to reduce costs and to maintain quality cannot but have been reduced by the sheltered markets provided by policies of automatic protection and strict control over domestic entry. Thus, in this sense these policies impaired India's progress toward industrial efficiency at the speed that a framework providing for more effective competition would have made possible.

NOTES

1. For a long review of the literature on the subject, see Bhagwati and Desai, *India,* pp. 13–37.
2. *Ibid.* See also Padma Desai, *Tariff Protection and Industrialization: A Study of the Indian Tariff Commissions at Work* (Delhi: Hindustan Publishing Corporation, 1970).
3. Cf. Morris D. Morris, *The Emergence of an Industrial Labor Force in India* (Berkeley and Los Angeles: University of California Press, 1965). The "sloppy" cotton textile entrepreneurs were thus "economically rational."
4. In this context, it is also useful to refer to our analysis of "shortfalls" in industrial investment in the post-1966 period that have little to do with the QR-regime as such. See Chapters 8, 9 and 11.
5. Frankena, "Export," p. 4.
6. *Ibid.,* p. 10.
7. Note that it is *extremely* implausible that Pareto-dominant techniques would be "inefficient" because their "externality" or "second-best-type" (e.g., impact on savings *à la* Galenson-Leibenstein-Bator-Dobb) effects are inferior!
8. *Ibid.,* pp. 11–12.
9. Cf. Tibor Scitovsky's classic paper, "A Note on Profit Maximisation and Its Implications," *Review of Economic Studies* 11, no. 1 (1943).
10. We should like to acknowledge Solomon Fabricant for his valuable comments on an earlier draft of this subsection.
11. A. Banerjee, "Productivity Growth and Factor Substitution in Indian Manufacturing," *Indian Economic Review,* n.s. 6, no. 1 (1971).
12. *Ibid.,* Table 3.
13. S. R. Hashim and M. M. Dadi, *Capital-Output Relations in Indian Manufacturing* (1940–64), The Maharaja Sayajirao University Economics Series No. 2 (Baroda, 1973). See references there to earlier studies of productivity in Indian manufacturing and for details on the methods of adjustment to capital data. Note, in particular, that these authors (like the others) have not been able to adjust the capital series for underutilization of capacity.
14. It would be useful to explore even this approach still further to see if any differential performance among different industries in the behavior of their total productivity indices can be observed and then related to the characteristics of these industries such as their degree of protection or their participation in export markets.
15. In the tea industry, moreover, the substantial British investment was being steadily pulled out and diverted to East Africa, so that there was no incentive to put resources into innovation and its implementation.

16. There are several conceptual and data problems with Tables 15–2 and 15–3, many of them discussed in the original sources. They should be regarded, therefore, as merely giving broad orders of magnitude.

17. See The Industrial Credit and Investment Corporation of India, Ltd., "Conference on Research and Development in Industry" (Bombay, 1971), pp. 10–12, for results of a sample survey conducted by the ICICI. The latter proposition, however, is only broadly true and is not corroborated by regression analysis.

18. The detailed results of this survey are reported in Ashok V. Desai, "Industrial Research and Development in India," mimeographed (New Delhi, April 1972). We have drawn extensively on this report here.

19. While we do not go into the expansion of design firms in India, which have developed extensive know-how in the design of Indian manufacturing capacity from indigenous talent and resources, this is a point of some importance in the present context. See Desai, *Bokaro,* for an analysis of the factors that interact with the development and deployment of such talent in the political and economic reality of national and international policies.