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Brazilian subsidiaries are learning to accept the importance of social and organizational innovations, but they certainly lag several years behind their parent companies in this respect. Indeed, contradicting international and to some extent even Brazilian experience, quite a number of foreign companies were not in the least inclined to acknowledge the viability of such innovations in their industry.

In the case of most foreign and many national companies, it seems that structural conservatism, unawareness of the benefits of new organizational concepts, and scepticism regarding their viability are major reasons for the relative absence of organizational and social innovations. Another factor is that as competitive pressure is low, enhancing flexibility and responsiveness are not presently matters of strong interest to machinery firms in Brazil. Beyond this, an industrial company obviously cannot handle all problems at once, and to many companies in Brazil it may seem that coping with erratic demand, fluctuating inflation, and profound and frequent changes in exchange rate, trade and industrial policies is more important than introducing innovations on the shop floor.

of quality, and productivity (NC/CNC machinery operates at much higher speed) and quality were indeed found to be the main motives for introducing this type of equipment. Quite a number of companies therefore face the challenge not only of introducing organizational and social innovations but also of investing heavily in manufacturing technology.

Contrary to our expectations, it hardly makes sense in our sample to differentiate between organizational and social innovations since in three out of four cases organizational innovations in the logistics area were associated with basic social innovations. It is noteworthy that all enterprises with organizational and social innovations are located in the hinterland of São Paulo; we found no such case in the city of São Paulo or its ABCD-region (i.e. the southern industrial suburbs). It seems that because of a history of highly conflictive industrial relations in São Paulo and the ABCD-region, neither capital nor labour is capable of imagining social innovations. Indeed, such innovations would have to be based on a sound basis of trust which certainly does not exist today. Although most companies reported a very low level of employee fluctuation and many reported having trustful relations with their workforces, the trust concerned is of the paternalistic type. We encountered only one enterprise (located in the interior) with a works council, with a more modern approach to regulating industrial relations.

However, we cannot argue that industrial relations are more “modern” in the interior of São Paulo state or in other federal states than in metropolitan São Paulo or its ABCD area. Paternalistic structures are present everywhere, even in companies where social innovations have been introduced. Unlike in industrialized countries, in Brazil it was not the workers fighting for participation who achieved these innovations.¹⁰ On the contrary, they were imposed on the workers in a voluntarist way by a paternalis-

tic management aware of modern management techniques. We discovered only top-down strategies and not a single case of interactive, participative planning of the restructuring of shop-floor operations. Brazilian enterprises thus have at best a limited view of social innovations. They make use of the worker’s knowledge in day-to-day operations but not in planning the production process.

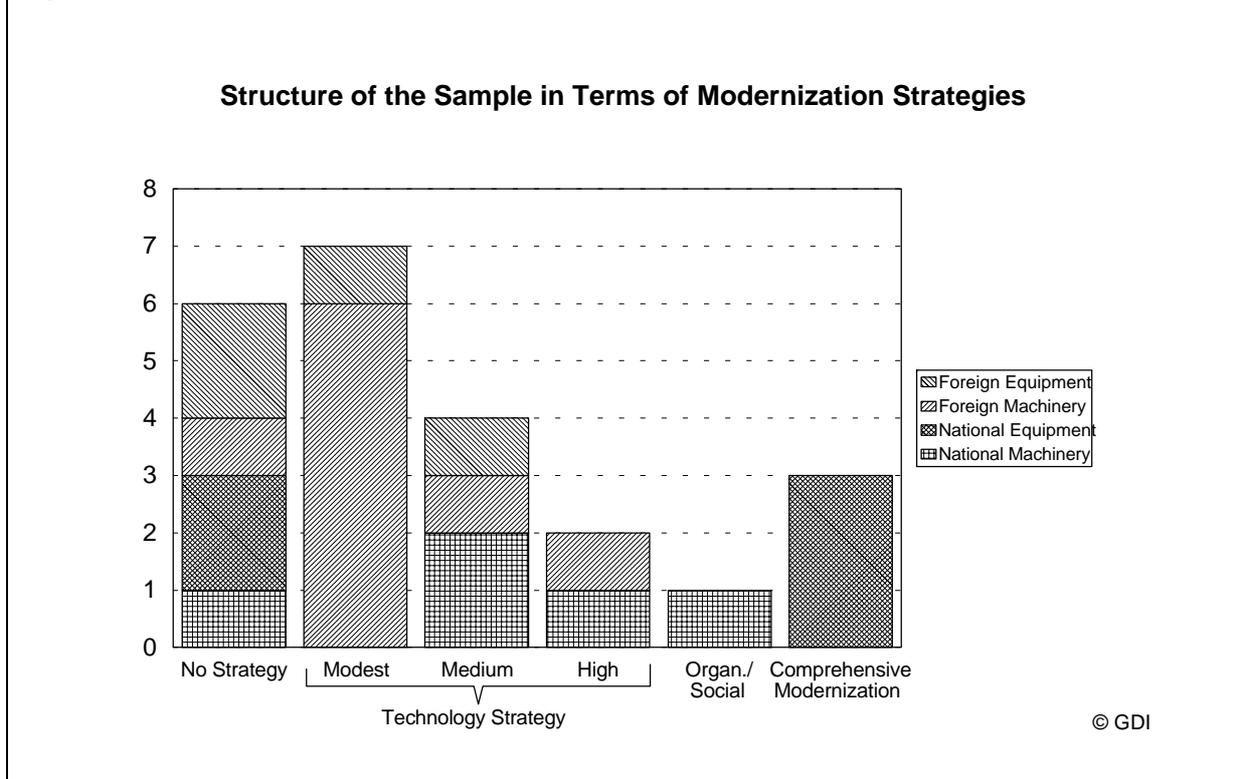
To some extent these facts can be explained by the position of the trade unions, whose main concern is the struggle for wage increases to counteract the downward wage trends of the past years. Another important issue is the struggle for power between different national federations of trade unions, a struggle which is being fuelled by the federal government which is trying to weaken CUT, the largest federation. Furthermore, particularly within CUT, socialist and reformist factions are still fighting about the general line of trade union policy. The preconditions for drawing up active trade union strategy on modernization are simply not fulfilled in Brazil.

We found no reason to believe that the skill level of the workforce is a major obstacle to comprehensive modernization. The main obstacle is in fact the unstable, unpredictable economic environment which deters investments and thus slows down the modernization process. Most companies seem to operate as if their market were to remain closed because they mistrust the government’s policy. They perceive the government more as a generator of turbulence than as an institution capable of bringing about a restructuring of production. This is particularly true of foreign enterprises. Although we found only very few companies which were considering closing down their Brazilian operations, foreign companies are generally somewhat more sceptical than national companies about the overall economic situation.

This hesitant, defensive posture of foreign companies may partly explain the fact that we did not observe “social technology transfer” within multinational enterprises in this sector. Probably

10 It should be pointed out, however, that we obtained our findings mainly from interviews with management representatives. As Leite (1989) found out in a case study, management representatives may present innovations as their own achievements when they were actually the result of years of struggle by the workforce.

Figure 4



- Companies without explicit modernization strategies: six cases, evenly distributed between the national and foreign, machinery and equipment categories.
- Companies with technology-oriented modernization strategies, where a distinction can be made between three types: seven are enterprises with a modest level of technical modernization, i.e. in most cases some CNC technology, most of them foreign machinery enterprises. Four are enterprises with a medium level of technical modernization, i.e. CNC plus CAD or MRP. Two enterprises have a high level of technical modernization, having implemented all three types of system and aiming to implement CIM.
- Companies focusing on organizational and social innovations: only one national machinery enterprise is pursuing this strategy.

- Companies with truly comprehensive modernization strategies: three national equipment enterprises have opted for this path.

These findings were not in line with our expectations. The level of technical modernization is somewhat higher than expected, that of organizational modernization somewhat lower. We would not say, though, that any enterprise in our sample is showing a tendency to repeat the industrialized countries' experience of "technical overkill". Even the scale of technical innovation is at best reasonable; in many cases it is very poor. Indeed, there are many reasons for not rushing to introduce new manufacturing technologies in Brazil, e.g. the very high price of the equipment and the very low price of labour. It therefore makes sense that we did not encounter any cases of flexible manufacturing systems or automated transport devices and only very few cases of flexible manufacturing cells and machining centers. Nevertheless, many company representatives held the view that certain parts can only be machined with CNC machines for reasons

two out of nine foreign enterprises). Of course, one could argue here that the national industry is under greater pressure to improve its quality.

The enquiries regarding strategy also concerned quantifications in terms of quality improvement. Although ten enterprises are following a strategy of technology and integration and even 17 enterprises have at least integrated quality control into the production process, only two enterprises could quantify the resulting improvements in quality. Both are national enterprises manufacturing capital goods (equipment industry). One enterprise reported reducing quality costs from 5% to 1.4% of its net profit. The other reported a reduction in waste of about 60% between 1987 and 1990.

The poor response to this question suggests that although all enterprises regard quality as very important, only very few address themselves to this issue systematically.

Of the 17 enterprises intending to pursue a strategy of integration and technology or at least integration, only 6 have so far also made changes to their organizational structure, defined as changes in the corporate hierarchy or a reduction or relocation of quality control personnel. The changes concerned were a shift centralized to decentralized quality control stations and the reduction or relocation of quality inspectors, in one case from 107 to 47.

4 Summary of findings

Two main conclusions emerge to summarize our findings:

1. A strategy of comprehensive modernization is viable in the Brazilian machinery industry and probably in Brazilian industry as a whole.
2. There are no clear-cut factors which explain why certain companies have opted to pursue this strategy.

Some of our findings did not verify our expectations. For instance, in terms of the spread of *new*

manufacturing technology we found no systematic difference between national and foreign companies; nor was there any identifiable correlation between high exports and the introduction of modern technologies. The degree of differentiation within both the foreign and the national group was striking: in each we found both CIM-oriented enterprises and companies with a very low level of technical sophistication. In the former group, the introduction of technology has not implied a tendency towards deskilling; on the contrary, the opposite seems to be the case. It can therefore be concluded that there is no tendency towards “computerized Taylorism”, i.e. substituting skilled workers by “intelligent” machinery. Considering the import restrictions it is somewhat surprising that companies do not consider access to technology to be a major obstacle. Not at all surprising, however, is the fact that national enterprises emphasize their limited equity capital and limited access to credits as being major obstacles to modernization.

Nor is there any systematic difference between national and foreign companies in terms of their utilization of *MRP*. In most cases the introduction of *MRP* has been accompanied by the extensive organizational restructuring which is a prerequisite for its efficiency. It seems that enterprises here are pursuing a strategy of “centralized decentralization” which tries to make detailed data available centrally while at the same time leaving a reasonable level of autonomy on the shop floor.

In terms of *organizational innovation*, we found only four cases of large-scale restructuring at shop-floor level, mainly in the form of introducing cellular manufacturing. Remarkably, all these cases were national enterprises (four out of ten), and three of them were in the equipment industry (three out of five).

There seems to be no general strategy to raise *quality* standards by the extensive use of computerized machinery. In this respect, firms tend instead to combine two approaches: introducing new testing and measuring equipment and integrating production and quality-assuring operations.

Summarizing these findings, we can distinguish four types of enterprise (Figure 4).

incentive for implementing JIT. As lead-times in this sector are generally long, the potential for reducing them is considerable. These enterprises did not agree that the high number of items involved represents a major constraint to identifying families of parts.

In our sample of nine enterprises, three national enterprises operate with a considerable internal JIT component. Not surprisingly, their most important motives for introducing internal JIT were reduction of stocks, changes in the turnover of stocks, and reduction of lead- and transition times. The most important obstructing factor was resistance from middle management, though opinions on this factor were not unanimous. The second obstructing factor was the vast organizational restructuring generally considered to be necessary when introducing JIT.

The references to these two problems signify that some enterprises in this sample have realized that introducing JIT is not predominantly a technical problem but requires an analysis of the organization of the production/assembly process. In many cases, this results in the dismissal of staff at middle management level.

3.2 The organization of quality

Due to the policies of import substitution and market protection, most markets in Brazil have an oligopolistic structure. Quality has therefore been a secondary issue until recently. The consumers of final and intermediate products had no alternative but to live with low quality standards. An international consultancy found that an average of 25,700 out of every million parts produced in Brazil are defective, compared to only 200 on the international market (Netz 1990, 97). As the opening of the market—a central element of the Collor government's industrial policy—will make quality an important determinant of competitiveness on the local market, Brazilian enterprises will increasingly have to address themselves to this issue.

Available evidence indicates that quality problems of Brazilian industry have two sources: an underdeveloped quality control/assurance system within

companies and an inadequate supply structure. Both are important factors within the framework of a comprehensive modernization strategy. Companies in the industrialized countries have started changing their internal quality organization.

One of the central elements of comprehensive modernization is the integration of hitherto distinct and separate parts of the production process, including product quality control which, with the conventional "exclusive format" was carried out as a separate operation. In the new strategy, quality is no longer controlled downstream but is assured by the shop-floor staff during the production process. The aim is "not to control quality, but to produce quality".

On the other hand, quality presupposes a high standard of technical equipment in the form of high-tech precision machines (e.g. CNC machines) and high-tech control equipment to measure quality.

We tried to classify the enterprises interviewed into the following three strategy categories:

- a) Technology—assuring quality by using high-tech equipment, in most cases high-tech control equipment;
- b) Separation—maintaining or enlarging of "external" quality control stations;
- c) Integration—transferring responsibility for quality to the shop-floor staff.

Since only one enterprise is pursuing a purely technology-based strategy and one other is pursuing a separation strategy, these two categories must be neglected here. A strategy of integration had been favoured by seven enterprises.

The technology strategy and the integration strategy are not mutually exclusive since nearly one half of the enterprises pursue a joint strategy of technology and integration, indicating a tendency towards comprehensive modernization in this area. The figures also indicate that national machinery companies are more interested than foreign companies in improving quality by pursuing a strategy of integration and technology (four out of five national enterprises follow this strategy, compared with only

Figure 3: Companies' Positions On Internal Just-in-Time

	Not feasible	Not necessary	Technological approach	JIT implemented	Special cases
Machinery industry	2	6	1 MRP 1 FMS	2	2
Equipment industry	3	2	—	3	1

make considerable reductions in the number of staff on the shop floor.

Both enterprises introduced teamwork within the cell. Workers in the team are expected to operate all the machines there, which initially meant that they had to undergo additional training. Additionally, responsibility for quality control was transferred to the cell team. Although a certain degree of control and supervision still exists, comparison with the pre-cell situation shows a relaxation in the division of labour.

A third enterprise operated with teamwork in the assembly area, where machines were assembled by a team and its foreman with the shop-floor workers being responsible for coordinating the assembly work.

The three points most frequently mentioned as an incentive to introduce JIT were reduction of stocks, improvement of order response, i.e. lead-time, and reduction of transition time.

As these objectives were mentioned unanimously, the question remains why only two of the enterprises have actively begun to implement JIT innovations. A more detailed examination of the obstructing factors reveals that macroeconomic problems are the main obstacles. Four companies considered the inflationary environment to be the decisive factor holding back JIT. The general demand situation was also considered to be an important factor, though this is a problem which has no directly obstructive impact. Obviously, fear of inflation is seen as the predominant reason hindering the introduction of JIT.

The enterprises which did not use JIT techniques pointed out two further arguments which appeared

to us to be the main “subjective” factors. Six companies stated that for their enterprise JIT was not necessary; two companies argued that JIT was not feasible (Figure 3).

These six enterprises emphasized that reducing throughput time has traditionally been one of their major concerns. They seemed to be fully satisfied with their performance and did not intend to further investigate into matter, largely, it seems, because their main customers are not demanding shorter lead-times. When asked about their perception of JIT, it turned out that their main concern was to deliver on time. This is generally accomplished by “working harder” when the time schedule is tight, an approach which apparently does not allow for systems solutions. The fact that two enterprises from the same subsector and with a comparable product range have successfully implemented JIT could cast some doubt on the validity of these statements.

As there is only one enterprise which has amply introduced JIT and a second which has implemented the rudiments of JIT, a search for common characteristics does not make much sense. Nevertheless, there is one conspicuous similarity: these two companies are among the largest in the sector.

3.1.2 Findings in the equipment sector

In the equipment industry the question of internal JIT was a highly controversial issue. Most enterprises in our sample stated that their batch size of one and highly complex production process made a JIT system non-viable (Figure 3).

By contrast, three enterprises stressed that the high complexity of the production process is a major

Unanimously, the enterprises saw the investment costs as the major obstacle to introducing an MRP system. Other factors were of relatively minor importance, though the responses differed clearly on the role of the lack of MRP vendors and lack of model enterprises. The divergence here can be explained by examining the dates when the enterprises launched started their MRP projects: early beginners suffered more from the lack of vendors than the latecomers. Regarding the lack of model enterprises, foreign companies attach less importance to this point than national companies as many of them have access to systems developed by/for their respective parent companies. However, even they differed considerably in their answers here, and even more so in those concerning the role of MRP vendors. Non-users attached less importance to all these points; presumably they are not aware of the problems linked to the introduction of MRP.

Four enterprises with well-developed MRP systems, only one of them foreign, reported that the introduction of the MRP system had been accompanied by changes in the division of labour and the materials flow within the enterprise. Two others reported changes in the division of labour, and two further companies had flanked the introduction of MRP with organizational changes to achieve internal JIT.⁹ A reasonable degree of reorganization had thus been undertaken to make the MRP system viable. However, reorganizing the factory did not necessarily imply decentralization: six enterprises integrated operational data collection into their system, indicating an intention to use the system for centralized monitoring, and only one enterprise reported systematically using the knowledge available on the shop floor.

On the other hand, nine enterprises reported having kept their informal information channels open. Although this seems to be inconsistent with the above statements, it is not necessarily a contradiction and can be interpreted as a tendency towards centralization and decentralization simultaneously: the management knows (or at least should know)

that the factory simply will not operate with rigid planning regime but nevertheless wants to maintain the *potential* to control any process at any time.

3 Results of the field survey: organizational innovations

3.1 Internal just-in-time (JIT)

Internal JiT is by no means widespread. Only five enterprises in our sample, all of them national companies, have introduced internal JiT. All have implemented cellular manufacturing, and two of them also reported additional innovations to rationalize the material flow.

3.1.1 Findings in the machinery sector

Identifying families of parts is generally considered to be the first step in implementing cellular manufacturing. Because batch sizes are larger in the machinery industry than in the equipment industry, we expected that machinery manufacturers would have fewer difficulties in standardizing their production and would therefore be in a better position for introducing cellular manufacturing. In fact, this was one of the main reasons for distinguishing between machinery enterprises (which we expected to be engaged more in serial production) and equipment enterprises (which tend to have much smaller batch sizes).

Surprisingly, only two of the 14 machinery enterprises had realized internal JIT, this after previously introducing cellular manufacturing. One of the two enterprises is still at an initial stage, manufacturing only standardized products representing an insignificant fraction of total production in the cell. The other enterprise with a relatively new concept of cellular manufacturing presents a different picture. Although internal JIT here is still in the initial, experimental phase (introduced in late 1990), this enterprise has been able to reduce its throughput time from eight to three weeks and at the same time

⁹ It is somewhat strange that two other MRP users explained that linking MRP with internal just-in-time is not feasible.

tion” is rated highly again shows the impact of the recession on corporate decision-making processes.

The factors “availability of equity” and “access to bank credits” are each given very different ratings which reflect the breakdown into foreign and national firms. For most of the foreign firms, availability of equity and credits is not a problem at all because of their financial linkage with the parent company. For national firms, however, technical modernization seems to be closely associated with financial problems.

A surprising result—particularly in view of the legislation on information technology—was the very low significance attached to “access to technology” as an obstructing factor. The firms in our sample reported having few problems in obtaining the type of technology they wanted. A glance at the circumstances of the various types of firms explains this result. The foreign firms have no problems in obtaining technology because of their connections with their parent companies which in some cases made it possible for them to circumvent the prohibitions of the information technology legislation. On the other hand, as most of the national firms which give a low rating to “access to technology” factor had not yet introduced computer-aided technology, it is not surprising that they are content with sourcing their technology from the national market. The few national firms which produce with relatively advanced technologies are somewhat more critical of the restricted access to technology, though without giving it a high rating as an obstacle to modernization.

On the matter of the compatibility of hardware and software, the answers from national and foreign firms differ significantly. The foreign firms have more problems probably because they use both national and foreign hardware and software.

2.2 The diffusion of computerized material resources planning systems

A material resources planning (MRP) system is usually introduced to

- enhance the transparency of the production process,
- reduce lead-time and throughput time,
- reduce stocks and work in progress.

In our research we found ten enterprises which operate computer systems with a degree of integration sufficiently high to presume the existence of truly computerized MRP; the degree of integration turned out to be the central criterion here since some enterprises designated their simple computerized stock administration systems as MRP systems. The other 13 enterprises included only one case of a failed attempt to introduce MRP, the failure here having been due to resistance from certain levels of management within this foreign company. Although failed MRP ventures are a rather familiar experience in industrialized countries, our survey did not identify such failures in any other companies (at least none admitted having had an experience of this type).

The group of ten MRP users comprised six national and four foreign enterprises, five machinery manufacturers and five equipment manufacturers. This distribution is surprising insofar as the non-MRP enterprises all agreed that the introduction of MRP made no sense for them because of the peculiarities of their products and production processes. Our findings do not support the view that MRP systems are unsuitable for companies manufacturing highly complex, highly customized products.

The main motives for introducing MRP were, not surprisingly, the wish to reduce delivery-response and throughput times, slash production costs, reduce stocks and improve capacity utilization. Enhancing proximity to the customer was seen as a minor motive. However, some differences did emerge between national and foreign companies. National companies rated reducing throughput time, reducing stocks and greater proximity to the customer significantly higher than foreign companies. It seems that national companies are more strongly committed to new logistics concepts.

- a focus on medium and larger enterprises since these present better preconditions (e.g. professional management) for handling comprehensive modernization;
- a mix of enterprises from different regions.

We selected 23 enterprises—five national and nine foreign machinery enterprises (machine tools and special machinery enterprises), and five national and four foreign equipment enterprises (see Table 1 in the annex). Our sample covered eight of the ten biggest enterprises in each sector in terms of turnover (according to data in Wogart 1989, 89 f.).

2 Results of the field survey: technical innovations

2.1 Computer-aided automation technologies in the production process

The main technical innovations in the production area are CNC or DNC facilities, flexible manufacturing cells or systems and other “CAX” elements (CAD or CAQ). In our sample, eleven of the 23 firms (48%) had not introduced any of these technical innovations. Of these eleven firms, nine belong to the equipment industry, two to the machinery industry, five are foreign, and six are national. Five firms had introduced CNC technology without other elements of computer-aided automation. All belong to the machinery industry, two are national and three are foreign. Six firms use CNC technology together with “CAX”-elements. Two of these are equipment industry firms, four are machinery industry firms, three are national, and three are foreign. In this group we found the only two firms which had implemented flexible manufacturing cells (one is a national machinery industry firm, the other a foreign equipment industry firm).

Of the 23 firms in our sample, eight had introduced a CAD system. No significant differences were found regarding nationality or type of industry.

With the exception of one case, however, the CAD systems were used only for limited tasks, e.g. special parts families or the design of electronic boards. We found only three firms which had networked CAD and CAM. Two of these are national, one is foreign, and all are machinery industry firms. Obviously due to the high investment costs, no company had yet introduced a flexible manufacturing system.

Concerning for the motives for technical modernization, it is no surprise in the current period of economic recession that “raising productivity” and “improving economic performance” are regarded as the most important motives. We did not expect, however, the high rating given to improving product quality. It can be assumed that there exists a certain backlog demand for precision machinery.

Reduction of lead-time is an important motive, especially for firms using advanced technology. All firms which have introduced just-in-time systems give a rating to reducing lead-time. This demonstrates the relevance of this factor in improving the production process. On the other hand it is surprising that two firms in the equipment industry see no necessity whatsoever to reduce lead-time by modernization; all other equipment industry firms give this factor a high rating. Views in the equipment industry on the importance of reducing lead-time clearly differ.

“Raising flexibility” and “improving innovation capability”, which are advanced as decisive advantages of computer-aided automation in literature, are not identified as important motives for modernization by the majority of the firms in our sample. It is interesting to note, however, that the technologically advanced firms rate these two motives significantly higher than the firms which have not introduced computer-aided technology. This may be a sign of the latter’s unawareness of the advantages of computer-aided automation. Obviously, flexibility and capability to innovate have not so far been important factors of competitiveness on the national market.

Regarding the factors which obstruct technical innovation, the fact that the “general sales situa-

It will have to upgrade its *product technology*. Compared to other NICs, Brazil is lagging behind technologically in this sector. One appropriate measure would be a significant increase in in-house R&D expenditure. The legislation on information technology should be amended to create a more flexible framework for importing microelectronic equipment.

Faced with periods of low or at least highly fluctuating domestic demand, the sector will have to look for new *export marketing channels* to avoid becoming paralyzed.

The lack of national technological upgrading has caused the gap between Brazil and its international competitors to also widen in terms of *process technology*. There is only little evidence of computerized equipment and new forms of production organization.

1.3 Research design

The non-electrical machinery sector (NEM) has never been a prime candidate for Taylorist rationalization strategies: small batch sizes were not compatible with transfer-line-based mass production, and the workforce has always had a comparatively high skill profile. This, however, did not prevent Brazilian enterprises from implementing Taylorist schemes, trying to augment the division of labour as far as possible in order to achieve the greatest possible control over the workers and the labour process. Comprehensive modernization, thus, is without any doubt an issue for this industry. In fact, it is a much more urgent issue here than in other industries which are currently mass-producing (e.g. automobile, electronics, household appliances and others). In our view, because of inherent sectoral characteristics and changes in international best practice, the Brazilian machinery industry is a very probable candidate for comprehensive modernization. This is even more likely since the regulatory environment for Brazilian industry is changing dramatically. For the sector, modernization is a question of do or die.

Based on the available literature, what we expected to find was

- an only moderate diffusion of new manufacturing technologies, i.e. CNC machine tools, flexible manufacturing cells/systems and CAX-technologies (CAD, CAE, CAQ); however, we expected the diffusion level to be higher in foreign than in national enterprises;
- relatively strong evidence of organizational innovation, i.e. cellular manufacturing using traditional machinery, new logistics concepts and total quality control;
- very little evidence of social innovation, i.e. devolution of responsibility to the shop floor (e.g. shop-floor programming), job-enrichment, a less pronounced division of labour, and teamwork.

The main questions were:

- Is a strategy of comprehensive innovation viable in the Brazilian environment?
- Can Brazilian enterprises become more competitive via a partial strategy, i.e. a focus on organizational modernization with only limited technical and social innovation?
- Is the skill level of the workforce sufficiently high to make a less pronounced division of labour viable?
- Are organizational and social innovations viable in an environment of notoriously conflictive industrial relations?
- Are there systematic differences between national and foreign companies?

To select the enterprises for the field study sample we applied four criteria:

- a reasonable mix of serial and non-serial producers;
- a mix of national and foreign companies;

mestic demand, and the source of growth shifted from private domestic demand to public demand. National as well as multinational companies set up operations in the capital goods industry.

In 1979, after the second oil price shock, public investment fell back and left the machinery sector with excess production capacity. The sector suffered a severe setback. The capital goods on demand segment reached its lowest level of production in 1984, when output was only 72% of the 1979 record figure. Serially produced goods slumped to their lowest in 1983 at only 53% of the 1980 output figure (BNDES 1988a, 75). The sector hardly recovered in the mid-eighties. Total output of non-serial capital goods amounted to only 50% of the 1980 output figure (Exame Agosto 1990, 211).

During the recession of the early eighties, employment was slower to contract than production. Nevertheless, the machine tools subsector was affected severely by cutbacks in public and private investments. Exports reached only three quarters of the 1980 figure in 1982, the number of machines sold that year was only 5% of the 1980 figure, and employment plunged to its lowest level in 1983 at 48% of its 1980 level (Porteous 1990, 8; Fleury 1988, 22).

Employment and output advanced slowly after the mid-eighties until this process came to an abrupt end when the new government took office in March 1990. For more than one year, Brazil faced extremely turbulent economic and political conditions, and the present situation of the machinery sector is therefore precarious:

- In the first quarter of 1991 its production fell by 70% compared with the same period one year previously.⁵
- The sector has experienced radical cutbacks in employment in recent months. Whereas lay-offs affected 44,000 workers in 1990, 20,000 work-

ers were laid off in January and February of this year alone.⁶

- In some companies 70% of installed capacity is already idle.

The present situation of industrial enterprises has been determined largely by two events: the overall recession and the end of import substitution policies. While producers of machine tools and special machinery are generally suffering under the impact of the recession, the heavy equipment subsector is more severely affected by the drop in domestic demand. This subsector's major problem is its strong dependence on public investments, as its enterprises have been producing mainly for large-scale government projects, e.g. power plants, ports, installations in the steel or petrochemical industry (Cruz and Silva 1990, 46). Public investments, already low in 1989, fell by a further 44.5% in 1990.⁷ One large heavy equipment firm reported not having received a single order over the past year. The financial situation of many enterprises has been aggravated by the state's habit of delaying payments.⁸

While opening up the market will have only a slight immediate influence on the heavy equipment subsector, the machine tools and special machinery subsector will be profoundly affected by the arrival of international competitors. With planned average import tariffs of 20% (Cruz and Silva 1990, 10), it will be quite easy to import technology and machinery of superior quality from international suppliers.

Today three main bottlenecks appear to jeopardize the future of Brazil's machinery sector: product technology, marketing channels, and production efficiency. Successfully handling the following challenges will therefore be of fundamental importance to the future of the sector:

6 Ibid.

7 S.Costa & S.Mossri, "Salario minimo ..", Folha de São Paulo, 17.03.91.

8 "Voith demite e culpa inadimplencia estatal", Folha de São Paulo, 07.03.91.

5 "Produção de maquinas cai 70%; setor pede apoio ao Congresso", Folha de São Paulo, 07.03.91.

as can be seen from the experience of some companies in the metalworking industry.⁴ In the early eighties (a time of grave economic crisis), the machinery firm Semco, for example, eliminated most levels of its hierarchy and switched to a system of self-regulated work teams. By so doing it succeeded in enhancing its productivity and competitiveness, even against competitors abroad (Semler 1988, 1989).

However, there can be no doubt that enterprises like Semco are exceptions. Enterprises producing for the domestic market prefer to practise business as usual. Technico-organisational-social change is thus accentuating the polarisation within Brazilian industry, with some internationally competitive best-practice enterprises at the one extreme and the majority of traditional enterprises viable only under a market protection regime at the other. Here, the ideas and structures inherited from import substitution represent a barrier to innovation.

The following example demonstrates some consequences of maintaining inherited organisational structures:

“In a production site of a metallurgy enterprise producing precision products and materials the very latest and expensive CNC machine tools were being introduced. The workers were not allowed to alter the programs developed by the programming department. However, they did so (without the management knowing this) in order to maintain a continuous production process. At the same time they demanded formal training in programming. This being rejected the workers one day decided not to correct the mistakes they discovered in the programs (what exactly accorded with the rules). The result was a paralysation of production in the following steps of production since the produced parts did not fit the norm although everything had been conducted according to the established rules.”(Fleury and Salerno 1989, 18)

This example raises two issues. First, it seems that the potential of Taylorism is overestimated and the scope for shop-floor-oriented schemes of organisation underestimated. Second (and most importantly), it is the explicit interest of the management which forms the basis for applying computer-aided Taylorism. “Managements want workers to follow orders, not improve the production process.” (Humphrey 1989, 32)

Workers and their trade unions do not necessarily oppose the introduction of new manufacturing technologies; on the contrary, they demand that such innovations be accompanied by a modernization of industrial relations (which in Brazil signifies guaranteed bargaining autonomy, for example), and an upgrading of the skill level of the workforce (Fleury and Salerno 1989, 16 ff).

1.2 Structural features of Brazil's machinery industry

The production of non-electrical machinery (NEM) contributes 2.7% to the GNP (1987), and it has a 9% share in total manufacturing value added, which makes the machinery sector Brazil's third largest industrial sector (after the chemicals and food processing industries).

Three events stimulated the build-up of a machinery industry in Brazil:

- The worldwide recession of the early thirties compelled Brazil—like other countries—to start substituting goods it had previously imported. National entrepreneurs (often of Italian origin) founded capital goods companies in that period.
- The opening of the country for foreign direct investment in the fifties attracted a number of international companies; in some cases they were encouraged to invest in Brazil by multinational companies producing consumer durables who found it difficult to import the equipment they needed.
- After the first oil price shock, intensified import-substituting policies led to an expansion of do-

4 See “O fantasma da obsolescência assusta o país”, *Exame*, 13.12.1989.

1.1 Comprehensive modernization: the Brazilian experience so far

The industrialization regime of the past put virtually no pressure on companies to operate to international standards of efficiency, and the economic and political instability of the past few years provided no incentive for introducing any profound changes. Moreover, given the state of industrial relations (which are paternalistic and at the same time highly conflictive) and the existence of a “capitalist class that has not gone through the civilizing experience of confronting and negotiating with its class adversary” (O’Donnell 1988, 294), implementing cooperative management concepts is an undertaking which can be expected to be fraught with difficulties in Brazil.

What Brazilian scholars currently report³ is a profound change in the *organisational structure* of industrial enterprises, with quality circles and new logistics concepts in particular having been introduced on a broad scale. The diffusion of *technical* innovations is less advanced; for instance, there are very few CNC machine tools or robots (Fleury 1988, Tauile 1988). Finally, *social* innovations are very rare, a fact which may be somewhat surprising in view of the presence in Brazil of several international automobile manufacturers. In the industrialized countries these companies rank among the pioneers of three-dimensional concepts of innovation (Jürgens *et al.* 1989). In Brazil they pursue a partial innovation strategy of “computer-aided Taylorism” plus partial Japanisation: technico-organisational innovations without relaxing the division of labour, without broadening skill recommendations, and without transferring responsibility to the shop floor (Schmitz and Carvalho 1989). Even just-in-time systems are only being implemented between enterprises, not within. JIT between enterprises implies merely shifting stocks towards the suppliers, and Brazil cannot thus secure the rationalisation effect which industrialized countries have achieved by restructuring their entire

logistics chain. Even the stabilizing effect of long-term supplier contracts is absent since such contracts have so far not been observed in Brazil (Lima 1989, 16; Posthuma 1990).

For enterprises in industrialized countries, quality and responsiveness vis-à-vis a volatile demand structure are as important motives for modernisation as cost considerations in the narrower sense of the term. Most Brazilian enterprises have few problems with the former two factors as it is not very difficult to sell high-price/low-quality products on the domestic market. They accordingly show a low propensity for R&D spending, a preference for short-term planning, resistance to joint undertakings to strengthen their technological base, and a tendency towards imitation and dependent behaviour (Fleury and Salerno 1989, 8).

There are three further reasons for the only sluggish spread of new manufacturing technologies (Schmitz and Carvalho 1989, 24; Lima 1989, 16):

- in an environment of low labour costs, automation is often economically not viable,
- the costs of automation technology are high,
- the general economic crisis has cut back the level of productive investments.

Nevertheless, radical technical change has recently invaded some parts of Brazilian industry, especially those producing for the external market.

“... the great motivating factor for modernisation and automation is competitiveness in the international arena. In the most advanced firms, the target is to at least remain close to the global best practice system. It is the international market which sets the standards by which the managers structure their decision-making processes” (Fleury 1988, 36; see also Alves Filho *et al.* 1989).

A strategy which aims to introduce not only technico-organisational innovations but also “post-Taylorist” industrial relations can work in Brazil, as can be seen from the experience of some com-

³ See Alves Filho *et al.* (1989), Ferraz *et al.* (1990), Fleury (1988), Fleury & Salerno (1989), Leite (1989), Lima (1989), Neto (1988), Prado (1988), Proença & Caulliraux (1989), Schmitz & Carvalho (1989), Silva (1990) and Tauile (1988 and 1989).

III Comprehensive Modernization on the Shop-Floor: A Case Study on the Machinery Industry in Brazil

1 Introduction

After decades of import-substituting industrialization Brazil possessed a complete set of industries. Brazilian enterprises were capable of producing virtually everything, though mainly at a relatively high price and with a somewhat dubious quality.¹ International competitiveness was relatively low, and manufactured exports relied to a large extent on state subsidies. Facing grave financial problems, however, the state could no longer sustain a policy of subsidization. Unfortunately, only few enterprises could meet international efficiency standards since in Brazil's inflationary environment, raising prices has always been a much easier option than raising productivity. Furthermore, after the 1980s, i.e. ten years of investment being deterred by a turbulent economic environment, the technological gap between Brazil and advanced countries was widening.

The maxim *business as usual* therefore could not be a realistic option for Brazilian entrepreneurs and policymakers. The National Development Bank (BNDES) was the first to react to this problem. Traditionally one of the agents of a development policy which tried to reduce dependency, in 1980 BNDES set about promoting Brazil's competition-oriented integration into the world market. This, the bank argued, should be based on internationally competitive private enterprises capable of investing in R&D, of producing efficiently and of cooperating with foreign enterprises (BNDES 1988a).

The new government which took office in March 1990 shared this view. It pursued a gradual opening of the Brazilian economy to international competition. The new policymakers considered the stagnation of Brazilian industry as being all the more grave in view of the radical changes taking place in industry at the international level. The old, Fordist model of industrial development via automation and intensive division of labour, which laid the foundations for the economic and social progress in the developed countries, is running out of steam. In the industrialized countries, industry's initial reaction was to intensify the old model, i.e. introduce computerized flexible machinery and try to govern the production process using information and communication systems. This, however, did not reverse the general trend of declining productivity growth (Bell 1990). After a phase of costly learning, enterprises reoriented their strategies. They began to understand the necessity of *comprehensive modernization* on the shop floor, i.e. linkage and articulation between *technical*, *organizational* and *social* innovations. It seems that this is essential for meeting drastically changing market requirements calling increasingly for *quality*, *flexibility* (i.e. the ability to produce very differentiated products) and *responsiveness* (i.e. the ability to react very fast to changes and differentiation in customer behaviour).²

Enterprises wanting to compete on the world market can therefore most probably no longer rely on a Taylorist rationalization strategy, one which delivers efficiency but an insufficient level of quality, flexibility and responsiveness. This means that Brazilian enterprises are facing a new challenge. Some of them have been exporting for quite some time to compensate fluctuations on the domestic market. The others will now have to face international competition as a result of recent changes in industrial policy, particularly regarding market access.

1 See Frischtak and Atiyas (1990), Sequeira (1990) and the results of a recent Brazilian industry survey presented in "Diagnóstico do atraso", *Veja*, 27 de Fevereiro 1991.

2 See for instance Rush & Bessant (1990), Ebel (1989) and Vickery (1989). The same issue is being addressed in the discussion on "lean production" (cf. Womack, Jones and Roos 1990).

in helping firms solve one limited problem at a time, or in areas like metrology and quality assurance where the existing institutional structure apparently leaves much to be desired (Ramos 1990). Increasing the involvement of the universities may require a change in their incentive structure, especially in terms of financing.

Strengthen the links between universities and vocational schools. Universities may play an important role in another field of technological upgrading, i.e. in the upgrading of the vocational training system. The level of education of teachers in vocational schools is often limited. Universities should offer special courses that provide special training and upgrading of the qualifications of vocational school teachers.

Do not pin too much hope on multinationals. Brazilian actors do not only have a certain tendency to fear multinational companies. They also show a tendency to pin a lot of hopes in terms of industrial modernization on them. Unfortunately, there is little evidence to support this hope. Multinationals will not modernize Brazil as they modernized Mexico; the latter case was special and can only be explained by the geographic location of the country. As a base for exports to the world market, Brazil's attractiveness is limited. It is somewhat better positioned regarding the regional market; but the regional market is largely identical with Brazil's domestic market. As long as this does not change, those multinationals already present will hardly feel inclined to mount heavy modernization efforts; and those which are not present will prefer to wait and see.

In fact, it will probably work the other way around: Once the Brazilian actors will have succeeded in getting their economy on track again, multinationals will start to invest in Brazil—in order to benefit from a striving local market, and in order to participate in the exploitation of advanced factors.

Since the technological gap between average local firms and local leading firms, not to mention global leaders, is big, the build-up of technology extension services is a primary task. It may be worthwhile to re-evaluate the experiences with agricultural extension services which seem to have worked reasonably well in the past (it may be mentioned here that the recent U.S. discussion on industrial technology extension draws heavily on the experiences with agricultural extension). In industry, extension services should only maintain a small administrative and technical apparatus. Their main function is to work as a mediator that organizes the contact between companies and consultants, university experts, other companies, retired executives and other knowledgeable persons.

The build-up of advanced factors is a particularly important task in those areas where static comparative advantages abound. Brazilian companies show a certain tendency to rest on static advantages; e.g., they rely on cheap inputs and put little effort into the improvement of production processes to make the best of these inputs. Some so-called traditional industries could perform much better if they changed this pattern.

Building advanced factors may turn out to be a self-financing effort. Over the last years, federal states have increasingly introduced tax exemption schemes in order to attract new investors; and municipalities have introduced levy exemptions in order to achieve the same goal (Lasmar 1994). The obvious result has been a race to lower taxes and levies, thus reducing the available resources for states and municipalities. This tends to weaken locational factors, as for instance resources for the maintenance of the physical infrastructure are lacking. If, on the other side, states or municipalities succeeded in the build-up of advanced factors (financing this e.g. by restructuring the budget), these factors will appear much more attractive for firms than tax exemptions. Thus, states and municipalities may substitute tax exemptions by advanced factors.

Stimulate the participation of trade unions in dialogue and modernize capital-labour relations. To a large extent, innovation means incremental innovation. Incremental innovation is a result of

continuous efforts to improve production processes and products. This is not exclusively nor even predominantly a task of engineers and technicians. Rather, it requires conscientious, responsible behavior of qualified workers. The autocratic, Taylorist organization schemes that prevail in Brazilian industry do not facilitate this kind of behavior (Carvalho 1993). Thus, the modernization of capital-labour relations is an important prerequisite for the modernization of industry. The participation of trade unions in consensus building can help in this process.

4.2 Specific measures

Stimulate the emergence of networks of enterprises. Specialization is a key to competitiveness. Specialization is not compatible with a high level of vertical integration. Reducing vertical integration requires the establishment of close relations between companies. Close relations rely on trust. This can be strengthened or weakened by the local culture and political structure (Storper 1993). Efforts to build a political consensus that include private business may thus have the important side effect of encouraging the build-up of a denser network of inter-enterprise relations.

Furthermore, the tax system ought to be changed so that it no longer deters transactions between firms.

Stimulate R, not D. The adequate way of stimulating innovative product development in companies is to put them under competitive pressure while at the same time supplying them with the advanced factors they need. Fiscal incentives cannot substitute for this. Fiscal incentives may be considered to support genuine research activities in companies; however, due to the problems mentioned alternative forms of support, for instance project-based financing, may be preferable.

Introduce incentives for universities to strengthen links with companies. Even if the universities can only play a limited role in the technological modernization of Brazilian industry, any existing potential should be used. This potential may exist in fields like ad-hoc-consultancy, that is

defining concrete measures; I will discuss them in the second part.

4.1 Framework conditions for technology policy

Redefine the division of tasks between the Union, the federal states and the municipalities. Given the weakness of the central state, the increasing competence of other societal actors, and the advantages of decentralized policies, a redefinition of the division of tasks between the Union, the federal states, and the municipalities is an important and urgent issue in Brazil. This does not necessarily require by an unilateral act of the central government or a reform of the constitution. Rather, the fact that the central government has a limited capability to deal with the problems of the country, be they current or structural, opens a window of opportunity for state and local governments.

In fact, in most industries the regional or local level is the most adequate level for supportive state action; in most industries competitive advantage is highly localized (Porter 1990). Thus, there exist many possibilities for state and local government to formulate technology policy measures jointly with societal actors, in particular private business. There is also space for private business associations to set up technology policy initiatives. In some cases, this requires the change of laws on the federal level. Many, however, can be adopted by state and local governments even under current circumstances.

Yet it should be pointed out that the uncertainty of local and regional actors about possible interventions and policy initiatives by the central government may actually undermine the propensity to formulate local or regional technology policies. The central government should therefore clearly restrict its range of activities to those areas where local initiatives are complicated (eg the support of newly emerging industries, or the formulation of programmes for branches that are scattered all over the country), and it should seek to encourage and stimulate local and regional initiatives.

Stimulate stakeholder's dialogues. Another great but nevertheless unavoidable challenge is a new approach to policy formulation (Esser *et al.* 1993). Until today, hierarchic governance is the prevailing governance modus in Brazil. The attempt of the Collor government to introduce fundamental changes without any significant effort in consensus building was the rule rather than the exception. Any effort to build something like a national consensus on the federal level, involving all important actors, appears like a Herculean task; probably, a much deeper crisis is required to facilitate anything of this kind. At the moment, it does already appear as a major challenge to mount an effort in consensus building at the municipal or state level.

Nevertheless, it should be worth the attempt. State governments might consider to introduce incentives that stimulate consensus building attempts at the municipal level, e.g. by financing the hire of non-local persons as moderators. External moderators who do not have any stakes in local politics may play an important—if not crucial—role in stimulating and managing such dialogue.

Build advanced factors. Technological advance is a means to enhance competitiveness; and competitiveness rests—in the terminology of Michael Porter (1990)—on the capacity of business associations and the state to provide advanced factors, i.e. an infrastructure that is particularly aimed at necessities of local industry (especially in terms of communication, transport, and energy supply); technology consultancy and extension services; vocational and technical schools, etc.

It is important to point out that these are only partially public tasks. Business associations can play an important role in this field (as they have done in Brazil in vocational training), eg by fostering company modernization programmes, by diffusing information about new technologies and new organizational techniques, by stimulating interactive learning between companies, and by stimulating information exchange about export markets and export techniques. Private consultancies are another important actor, especially in the diffusion of technological and organizational know-how.

Northeast is limited; it is not certain to what extent recent experiences in Ceará to contradict this statement. Moreover, so far redistribution schemes on the federal level have been much more successful in creating individual fortunes than societal welfare. In order to reduce the economically dominant position of São Paulo, it makes much more sense to encourage other states, especially in the South, to develop on their respective potential.

Technological autonomy vs. technology capability building. At times, the technology policy discussion still follows the traditional lines of dependency argumentation.¹³ A number of actors continues to advocate a policy that builds technological autonomy, i.e. a local base that reduces the country's dependency on technology imports (and the problems of access and of predatory pricing that may be linked to them). Although terms like quality, productivity and competitiveness are fashionable today, the notion of a strong interrelation between world market integration, specialization, competition and technological learning is not widely supported.

Technology imports vs. technology capability building. Although technology imports (including capital goods imports) have continued to be low even after the reduction of customs tariffs, Brazilian company executives seem to perceive technology purchasing as the superior alternative to in-house efforts (Fleury *et al.* 1990). They often fail to notice that technology purchases and in-house efforts in technological learning are complementary activities. The full potential of technologies which are new to a company can only be exploited after extensive adapting of the technology as well as the company's organizational structure.

High-tech vs. high-performance industrialization. Many Brazilian policy makers and scholars are fascinated by fancy high technology. They tend to perceive entire industrial sectors as either high or low technology, equating this with high or low growth potential. They have not noticed that most

industrial sectors feature low as well as high technology segments (and in fact Brazilian industry tends to operate in most sectors, including computer equipment, in the low technology segment); and that many so-called low technology sectors (eg toys or furniture) have a much stronger performance in the world market than some high technology sectors.

The role of multinational companies. The multinationals who have affiliates in the country are often still perceived as predators who just benefit from the local economy without giving technology in return. It has not come to the mind of many Brazilian actors that this behavior is not due to the very nature of multinationals; rather, it was exactly the import substitution policy that allowed the multinationals to sustain a low level of technological sophistication (Gonçalves 1993). Thus, they behaved in no way different from national firms; and just like them, they are targets of the opening policy.

4 New approaches to technology policy

In the process of transition from import substitutions, many countries have chosen to refrain from technology policy—deliberately, as they believed in the neo-liberal laissez-faire gospel,¹⁴ or by default, since they lacked the capacity to formulate and implement it.¹⁵ Brazilian policy-makers seem determined not to follow these examples. Yet they face the problem that the fundamental change in the industrial development model also requires a fundamental change in technology policy. A new approach to technology policy requires a new philosophy; I will outline some possible elements in the first part of this final chapter. Furthermore, there are a few clear priorities when it comes to

13 See, for instance, CPMI (undated), in particular p 203 ff, paragraphs 13, 24, 28, and 41.

14 For instance, this apparently was the case in Mexico and Argentina (Perez-Nunez 1994, Nun 1993).

15 This applies to countries with severe structural deficiencies like Bolivia (Messner 1993b) or Tanzania (Gocht and Meyer-Stamer 1993).

ciently educated. More specifically, there will be a distribution between a small number of fairly good school graduates (who will typically opt for secondary and tertiary education) and a very large number who present an insufficient level of literacy and basic mathematical-technical understanding. It seems plausible to assume that this uneven supply structure is matched by an equally uneven demand structure, where better paying medium and large enterprises are in a privileged position to choose among the better qualified school graduates. Therefore, we may assume that the sad state of the education system introduces another factor that disfavors micro and small enterprises, making it difficult for them to achieve an adequate level of technological sophistication and competitiveness.

3.4 Some questionable assumptions of the Brazilian technology policy discussion

The transition to more promising technology policy initiatives is made difficult by a number of basic assumptions that are widespread in the Brazilian discussion.¹¹

Hierarchic vs. heterarchic governance. By and large, Brazilian policy makers and scholars have perceived technology policy as an activity that is best left to the federal government; some are still dreaming of a competent, strong, insulated state apparatus. For three reasons this concept is misleading. First, currently the capability of the central government to formulate policies is limited (Holanda 1993), and its ability to use any kind of financial instruments is even more limited due to the permanent budgetary crises. Therefore, proposals for comprehensive policy packages are inappropriate. A report by a special commission of the Brazilian Congress published in 1992 provides an instructive example.¹² The problem is not that the policy proposals as such are inappropriate; some

are (especially those calling for a continuation of 'market reserves'), but most are perfectly reasonable. The problem is rather that the report contains nine and a half narrowly printed pages with all sorts of policy proposals, but lacks any clear prioritization.

Secondly, the complexity of economy and society has increased, and so has the level of sophistication of societal actors. The situation today is much different from that in the fifties or sixties when the planning capability of the central bureaucracy may have been higher than the capability of any other group of society. Today, many companies and associations are at least as well informed and technically competent as the government bureaucrats. Furthermore, the government's ability to stimulate any kind of activity by any group of society (and especially by companies) is severely hampered by the mistrust of or even hostility toward the central government have emerged over the last years among societal actors. Therefore, it is not likely that the traditional model of hierarchic governance will work in the future. Rather, a heterarchic model, i.e. a model where various governmental and non-governmental actors interact, will have to emerge.

Thirdly, state and local governments naturally have a role to play in technology policy. They are in a much better position to identify the bottlenecks and the specific needs of companies and to implement specific policy measures. However, they have hardly done this until very recently; activities like the state of São Paulo's efforts to stimulate technology transfer between state universities and institutions the Institute for Technological Research (IPT) and industry have been the exception rather than the rule. The Congress report mentioned above does not even mention the possibility of decentralization in technology policy.

Regional development vs. development of regions. Brazilian policy makers are skeptical about the decentralization of tasks and responsibilities because this might widen the gap between more and less advanced federal states. Given the dominant position of the state of São Paulo, this concern should not be neglected. However, it has to be accepted that the development potential of the

11 This part is based on personal experiences in numerous discussions with Brazilian policy-makers and researchers.

12 CPPI (undated).

nies. More often than not, the physical or chemical fundamentals of a new technology are not well understood when it is being launched; it is only afterwards that basic research starts to investigate into them.

Moreover, there is evidence that some industries are much more inclined to maintain close contacts with research institutions than others. According to Pavitt's typology (1984), this is most likely to happen in science-based industries like electronics and chemicals. In scale-intensive industries and among specialized suppliers, technological advances are typically generated in-house, or stimulated by users or suppliers. Manufacturers of consumer non-durables rely on suppliers for technological advances.

With a view at Brazil's industrial structure, both findings have important implications for attempts to link university research and companies' product development. There are few high-tech, science-based industries in Brazil—the electronics industry has transformed itself into a final assembly industry after the removal of high import barriers (Doria Porto 1993), the pharmaceuticals industry is largely based on reverse-engineering, and biotechnology and genetic engineering are only incipient (Galhardi 1994). Thus, by far most Brazilian companies will not encounter problems that can only be resolved by scientific research. They are facing problems for which solutions are available in other companies and countries. In order to adapt these solutions to their particular circumstances, Brazilian companies will have to put more effort into technological learning and capacity building. There is little reason to believe that universities are of much help in this process (except for the education of engineers). Universities rarely are good in scanning the practically oriented technological know-how that is available world-wide; and there is little reason to believe that a university researcher should be better in adapting transferred technology than a company engineer. Thus, the stimulus to enter into joint activities with universities is very low. Looking at things in this way, it is not at all surprising that university-company-links are weak in Brazil.

3.3 Implicit vs. explicit technology policy

The government's explicit technology policy initiatives are often at odds with the implicit technology policy, i.e. the effects of other policies on technological activities in the companies. Some policies produce factors that affect all firms, others favour medium and large firms and thus discriminate against micro and small firms. (It should be mentioned here that the prevailing notion in Brazil is that a positive correlation exists between firms size and technological effort,¹⁰ a notion that is not supported by evidence from other newly industrializing and industrialized countries [Acs and Audretsch 1992]).

Economic instability. An important consequence of the unstable, unpredictable economic environment of the 1980s and early 1990s is a general short-term orientation of companies (World Bank 1994). In Brazilian terms, medium-term means one month, long-term one year. This environment deters technology capability building which is generally a long-term venture.

Taxation. Inter-company transactions are subject to relatively high, cumulative federal and state taxes (World Bank 1991). This means that vertical disintegration and specialization are being punished by taxation policy, and vertical integration is stimulated. This makes it difficult for companies to direct their technological efforts towards certain promising areas. Instead, companies will tend to spread their already insufficient technological effort over a broad spectrum of activities.

Neglect of the education system. Nowadays, it is a generally accepted fact in Brazil that the education system, especially in primary education, is in a poor state (eg Ribeiro 1993, Gomes-Neto and Hanushek 1994). Drop-out- and repetition-rates are high, payment, morale and qualification of teachers is low. Therefore, the average youth will be insuffi-

10 A special commission of the Congress even proposed a pro-trust- rather than an anti-trust policy in order to create large firms capable of financing R&D (CPMI undated, p 204. The commission conducted its hearings in 1991 and presented the report in 1992).

is fairly limited. There exist various semi-legal means of tax evasion and a general habit to exploit them (World Bank 1994). The saying goes that even leading companies locate some of their activities in the informal part of Brazil's economy. Thus, there is some reason to doubt that Brazilian companies do actually consider fiscal incentives as a stimulus for any kind of activity, let alone innovation. Moreover, it may be assumed that fiscal incentives for R&D only add more complexity to an already overly complicated tax system so that firms perceive them more as part of a more general nuisance rather than as a stimulus.

3) Fiscal incentives that refer to income taxes by definition benefit only those companies which are profitable. However, they are not necessary those which put most effort into R&D. Under the prevailing conditions, those companies which are most profitable are more likely to be most inventive in terms of financial management. Therefore, income tax related incentives will have a very limited effect.

4) Fiscal incentives are not necessarily maintained for a long time period. This can not only be expected due to the erratic macroeconomic management that has prevailed in Brazil in the past. Moreover, the actual costs of R&D incentives are unpredictable (OECD 1994); if lawmakers perceive that these costs become too high, they may be tempted to withdraw the incentives. Economic agents may expect this and therefore will not necessarily change their long-term strategies because of fiscal incentives.

3.2 University-company links

Brazilian policy makers are pinning great hopes on initiatives to stimulate stronger links between universities and companies. Unfortunately, the prospects for this kind of venture are remain limited even under the new economic framework conditions. There are various problems on the supply as well as the demand side.

Supply side. The quality and capability of the universities vary widely. The number of high quality universities is limited. In many federal and

most state and private universities the quality of the staff is comparatively poor (Castro 1989). One should not place too many hopes on their ability to give substantial support to private businesses.

Moreover, university researchers show a tendency to direct their research along the lines of research in developed countries. Research activities in universities in developed countries may be influenced by technological problems of companies; but this is not necessarily so, and even if it was it would be the problems of First World companies that compete at the leading edge of technology. However, competing at the leading edge of technology is something that only very few Brazilian companies do.

Then, there remains the question whether there really are incentives for universities, especially for leading universities or scholars, to enter into cooperative ventures with private companies. Compared to other areas of public services, especially the rest of the education system, the financial situation of the universities has not been too bad, and after the downturn in the early 1990s the situation is improving again, not the least due to foreign funding, especially from the World Bank and the IDB. Paradoxically, foreign aid and funding agencies which are keen to support the Brazilian science system may in the end inhibit stronger university-company links. Foreign donors will predominantly turn towards leading Brazilian scholars with an international standing and international contacts. These scholars may even find themselves in the comfortable situation of being able to choose between different offers of foreign funds. This certainly will not stimulate their efforts to find funding from domestic companies.

Demand side. It is now well documented that the traditional waterfall-model of the diffusion of innovation, from basic research to product development, does not at all match the reality. Rather, there is a interactive process of innovation (Rosenberg 1990, Pavitt 1991). This means that in many cases the waterfall flows bottom-up—technical problems in product development stimulate applied research, bottlenecks in applied research stimulate basic research. For instance, research in solid state physics has been stimulated by technical problems of microelectronics compa-

and efficiency. This has been accompanied by a number of technology policy programmes.⁷ However, they were either not implemented, or only after long delays, or have had little impact so far because the recession inhibited private sector investments. Even the Quality and Productivity Program (Programa Brasileira de Qualidade e Produtividade, PBQP) that has pursued an innovative approach (mainly trying to build a consciousness for quality issues inside firms) and got a lot of publicity in Brazil apparently has only had a limited impact (PBQP 1992).

Brazilian policy makers and researchers tend to explain the limited effect of technology policy initiatives with the economic crises and the low investment propensity of companies. I will argue that some widely favored policy initiatives have limited prospects to succeed even under improved economic conditions. This is due to certain structural features of the Brazilian economy and science system; I will discuss the cases of fiscal incentives and, again, university-company-links. I will point at some implicit technology policy measures that undermine the effects of the explicit technology policy.

3.1 Fiscal incentives

Brazilian policy makers perceive fiscal incentives as a major, if not the central technology policy instrument. Throughout the 1980s, the proponents of the informatics policy have unsuccessfully tried to establish a system of fiscal incentives; and the industry and technology policy projects of the Collor government put heavy emphasis on fiscal incentives. Policy makers are pinning great hopes on a law, passed in 1993, that introduces fiscal incentives for firm R&D.⁸ However, there are some major problems with the use of fiscal incentives in technology policy.

1) From a strictly economic point of view, the justification for fiscal incentives for R&D is much more linked to R than to D. In industrialized countries, innovative behavior, i.e. a high development effort, is simply a basic feature of any competitive strategy, and this needs not be stimulated by fiscal incentives (even though they exist in some countries); rather, companies simply will drop out of the market if they do not undertake this effort. In Brazilian companies, the larger part of R&D outlays is in development. It reflects the specific characteristics of the Brazilian industrialization experience that policy makers consider to stimulate 'normal' behavior, i.e. systematic product development efforts, with fiscal incentives.

Contrary to D, fiscal incentives for R are justified. Research activities in companies generally generate externalities. One can even easily imagine a situation where the externalities are much larger than the direct benefits to the company. Therefore, incentives for R are not only a compensation for externalities. They may stimulate companies which hesitate to enter into R because of high risk and uncertain benefits. However, it must be pointed out that, contrary to the proposition of neoliberal economists who usually recommend this, the support for basic research definitely discriminates since different industrial branches to a very different extent pursue activities that are formally being counted as research. The formally accounted research and development expenditures are high, for instance, in the pharmaceutical industry (8.7% of turnover) and low, for instance, in the pulp and paper industry (0.3%).⁹ However, it is certainly wrong to assume that the pharmaceutical industry is being 29 times more research intensive than the pulp and paper industry. Rather, the big difference is due to the fact that a considerable part of the innovative activity in the pulp and paper industry is part of ongoing activities in process engineering that are not being separately counted as R&D.

2) A practical point is linked to the fact that the discipline of Brazilian companies to pay their taxes

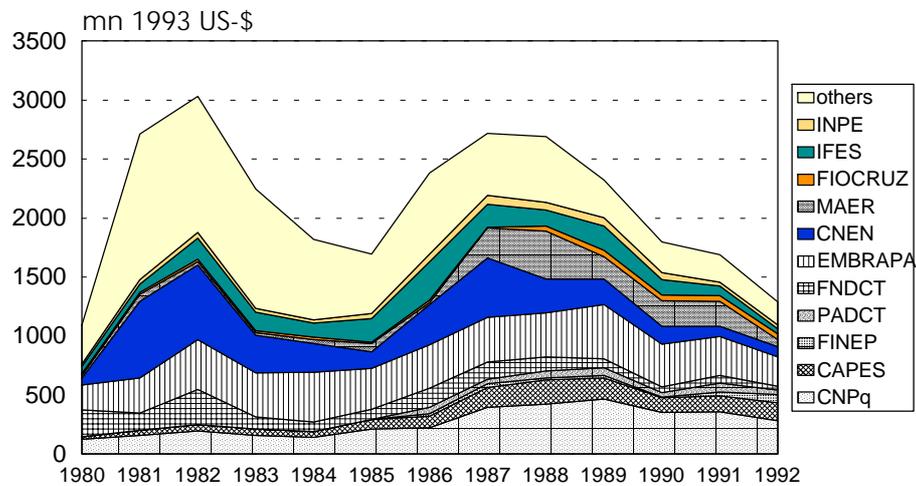
7 For an overview see UNIDO (1992a, 1992b).

8 'Incentivos fiscais: Investimentos em P&D devem crescer muito em cinco anos, diz ministro', *Gazeta Mercantil*, 18.07.1994.

9 1980 data for OECD countries; see OECD/TEP (1992), p. 32.

Figure 2

Brazil: R&D Expenditures by Major Executing Agency



Source: Ministry for Science and Technology (MCT 1994). - CNPq=National Science Council; CAPES=Graduation scholarships; FINEP=Project financing; PADCT, FNDCT=Funds for scientific and technological development; EMBRAPA=Agricultural research; CNEN=Nuclear research; MAER=Air force ministry; FIOCRUZ=Medical research; IFES=Higher education; INPE=Space research

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By and large, the environment for research activities during the 1980s deteriorated not as much as some observers have stated (eg Bastos 1993). In fact, after decreasing in the crisis of the early 1980s, the government R&D allocations grew by 50% between 1984 and 1987 and remained high until 1990 when it started to drop again (Figure 2). In the second half of the 1980s, the core funds for S&T development (CNPq, CAPES, FINEP, PADCT, FNDCT)⁶ remained reasonably stable. Nevertheless, there can be little doubt that the framework conditions for research became less friendly. Even if R&D funds did not decrease, they became unpredictable as the federal government tried to reduce its deficit by delaying the allocation of all sorts of funds (Franco 1993). Moreover, as budget allocations did not keep up with the growth of the science system, the competition between different research groups became intense; apparently, it moved from healthy rivalry to a situation

that was marked by mutual mistrust and open hostility (Castro 1989). This implies that there is not only no national system of innovation with a dense tissue of relationships between science and technology institutes and the productive sector. Possibly even the science system does not really deserve this name since the term 'system' suggests the existence of horizontal links and interaction.

3 Technology policy in Brazil: Old approaches to a new situation

In 1990, the government has radically changed the framework conditions for industrial development. Acknowledging that the import substitution model had run into a dead end, it opted for a policy of gradually opening the market to foreign competitors, thus creating an environment that requires international competitiveness and thereby forces companies to attain international levels of quality

6 For a detailed discussion of the history and profile of these agencies see Dahlman and Frischtak (1993).

There were only few exceptions, like the aircraft industry where a Brazilian firm tried to compete at the leading edge in the world market for commuter planes (Frischtak 1992), or in oil exploration where the internationally available know-how on deep water exploration apparently was limited (Hawrylyshyn 1991), or in the production of alcohol fuel that simply did not exist anywhere else. In these cases, firms have set up a systematic R&D effort and have also cooperated with universities and research institutes. Thus, some *sectoral* innovation systems have emerged. However, the claim that there is a *national* system of innovation¹ is misleading. Rather, the case of Brazil supports the notion developed elsewhere that what has been labelled the national system of innovation should rather be called national system of institutions since it is the broader framework conditions that shape the way innovations are, or are not, taking place in a given economy.²

In 1976/77, there were 1,050 firms that included R&D expenses in the tax declarations. This number shrank to 780 until the end of the recession of 1981/83 and then again grew to 1,090 in 1985. The average R&D/turnover ratio of these firms was only 0.4% (Dahlman and Frischtak 1993, p. 425). No less than 62.5% of the R&D expenses came from state companies, eight of which accounted for more than half of the total. The low R&D effort on the side of private firms is being confirmed by look at the data on research personnel. In 1986, the clear majority of the 52,863 persons worked for the state—62% in universities, 20% in technology institutes, 3.4% in state firms and 6.1% in other government bodies. Further 6.5% worked for private universities, which leaves 1.9% for private firms. This points to the fact that the number of firms who are seriously and systematically investing into R&D is far lower than 1,000; Brazilian observers have offered estimates that range from

more than 200 to 366.³ The true R&D/turnover ratio may have been as low as 0.16% in the early 1990s.⁴

Most Brazilian firms did not have R&D departments. They are an important feature in the organization of R&D cooperation with external agents since they form the major recipient structure for the internalization of research results from external sources. In fact, as a rule Brazilian firms did not confront problems, challenges, and opportunities that would have made it necessary or advisable to look for research results or external research support. Therefore, researchers in universities and research institutes had to have the impression that there was little potential demand for their results in industry. Yet, this was only one reason for the clear separation between research and industry. Other reasons were⁵

- the ready availability, particularly in the 1970s, of research funds from public financing institutions; this gave the emerging scientific community a lot of leeway in defining research priorities according to individual interests;
- the research ideals that PhDs returning from abroad brought with them; this made them strive for academic reputation rather than practical application of their research results; they often also oriented their research so that it fit into the line of activity of their foreign alma mater rather than addressed domestic bottlenecks;
- the introspection that emerged inside the science system since the early 1970s; communication mainly took place between people from research institutes, universities, and public funding agencies; reputation and career perspectives were dependent on the peer evaluation inside this circle, not on aspects like successful cooperative links with firms.

1 This has been claimed, for instance, by Frischtak and Guimarães (1993), Castilhos (1992) and Villaschi (1992).

2 This has been tentatively suggested by Nelson and Rosenberg (1993) and Nelson (1992) and more explicitly been formulated by Soskice (1994).

3 Marcovitch (1990), p. 106, and Dahlman and Frischtak (1993), p. 426, respectively.

4 Calculated from data in Villaschi (1992, p 53) and UNIDO (1993, p A-18).

5 See Castro (1989) for a detailed discussion.

II New Departures for Technology Policy

1 Introduction

This chapter further elaborates on the observation that there is no national system of innovation in Brazil. What has emerged in the era of import substitution was hardly system and limited innovation: Apart from a few isolated cases, there was little interaction between universities and technology institutes on the one hand and industrial firms on the other; and the firms themselves could prosper on the basis of limited innovative efforts. This, I will argue, has to do with the incentives that both sides were facing in the import substitution era.

I will then outline what role technology policy can play in the period of transition to a more competitiveness-oriented industrial development model. I will discuss different approaches to and instruments of technology policy. I will then discuss a number of questionable assumptions that are widely held in the Brazilian technology discussion and that make the transition to a more effective technology policy difficult. Finally, I will elaborate a number of policy proposals as well as address the question of an appropriate governance structure (between government and societal actors, but also between different levels of government).

2 Why there is no national system of innovation in Brazil

In the past, national development policies as well as development cooperation have been based on the notion that one key ingredient for industrial development was the existence of a science and technology infrastructure, and that science and technology institutes and industrial firms would somehow automatically join their hands in the development of technology. This notion was based on the experi-

ence of advanced industrial countries, and the experience of countries such as the East Asian NICs has underlined the fact that there is a certain truth about this notion. However, in most developing countries policy makers failed to notice two points. First, institutes that try to conduct basic research often fail to contribute to technological development. Second, there is no automatism at all that leads to the establishment of close relationships between research institutes and industrial firms. Whether or not this happens is largely dependent on the incentives that actors on both sides face. The fact that some actors in some places have deliberately ignored the prevailing incentive structure (i.e. have put a lot of effort into moving close to the technological frontier without pressure that forced them to do so) has sometimes confused the observers as to what these incentives really were.

In the particular case of Brazil, the prevailing incentive structure first of all did not stimulate innovative behaviour inside firms, at least not in the way it is normally understood in industrialized countries. This is not to say that Brazil was a stationary economy with no technical change at all; the contrary has been documented (eg Sercovitch 1984, Teubal 1984, Dahlman and Fonseca 1987). However, the larger part of technical change followed the typical pattern of inward-oriented latecomer industrialization where firms try to master technologies that have been developed elsewhere, try to adapt them to their needs and possibly try to improve them so that they better fit into the local environment. 'Typical R&D efforts would be determined by the need to use different raw materials, scale-down (to smaller) plant size, diversify the product mix, change the product design, use simpler, more universal, less automated and lower capacity machinery, stretch out the capacity of existing equipment, etc.' (Teitel 1987, p. 109). This kind of activity does not particularly require intra-company R&D but rather process engineering activities.

In the closed market environment, firms felt little pressure to extend their technological effort beyond incrementalism. With the degree of competition being low, they had little incentive to introduce truly innovative products or to look systematically for radical improvements in the production process.

government and to strengthen the technical capacity of the public service, but also for actors on different levels to learn how to actually use the space that opens for policy initiatives. It will also take some time, and a lot of effort and goodwill, to overcome the mutual mistrust among actors. It may happen that different trends reinforce each other in this regard: Changes in the electoral system may stimulate a greater coherence of political parties; this may make recruitment processes more transparent and predictable, thus reducing the suspicion among actors regarding their respective political ambitions. Changes in the political parties again should facilitate the construction of a reliable base of the executive in the Congress, thus making it easier to get beyond *ad hoc* deal striking to the formulation of medium-term projects. A changing role definition of business associations and trade unions may facilitate the shift from clientelism and traditional corporatism to pluralist lobbying efforts and the set-up of policy networks.

But the prospects for a comprehensive, Korean-style industrial policy that tackles various

problems in various industries at the same time remain dim. The single most important policy instrument over the past four years has been foreign trade policy. Whenever the government felt that a certain industry did not make a sufficient effort in restructuring it reduced the respective customs tariffs in order to put more pressure on firms. Future initiatives to also support industrial restructuring will have to depart from the traditional top-down approach; they will have to be based on new role definitions of the actors involved. They will have to be more specific; and they should be based on the thorough separation of roles and tasks between different levels, that is the local, regional and national level.

The transition from hierarchical to network-based governance is a difficult task, and it certainly is the opposite of a quick-fix to solve the shortcomings of a weak government. Shifting responsibility for policy-making into the society can only work if the government is sufficiently strong to prevent policy networks from running amok, that is introducing discriminations, abolishing competition in the market, or redesigning clientelist links. If this can be avoided, policy networks on the meso level can help to overcome the problem of persistent overburdening of the government. Efforts to reform government may then focus on establishing a capacity to perform context control, that is supervising the functioning of policy networks, rather than trying to re-establish a capacity to guide other societal actors. These are demanding tasks, and it would be a big step forward if the Brazilian state could fulfil them.

operate under totally different conditions than in the six decades of import substitution before, having to increase their competitiveness rapidly—and, surprisingly, many have so far proved to be reasonably adaptive (IE/Unicamp *et al.* 1993). More precisely: they have started to adapt after a certain period of hope that they might be able to revert the political decision.

Second, there is a new type of approach to industrial policy in the so-called sectoral chambers. In the Sarney era (1985-89), sectoral chambers existed as a forum for bargaining to control prices. The early Collor government tried to set up Executive Groups for Sectoral Policy (GEPS), but this attempt to articulate policy initiatives with private industry bore little fruit due to mutual distrust. In spring 1991, sectoral chambers (*câmaras setoriais*) were set up, initially with the aim of containing inflation in a period of phasing-out the general price and wage freeze (Salgado 1993). The chamber for the car industry, however, turned later into a fully fledged attempt not only to restructure the industry but also to revitalise the whole economy and, indeed, was successful. It was made up by State representatives, the associations of the car and car parts industry as well as the dealers, and the peak organizations of the trade unions. The deal they struck aimed at dynamizing the sector, mainly by reducing the price of cars (by tax reductions, rationalization, and smaller profit margins) and stabilizing industrial relations. Although this does not exactly qualify for an advanced version of a policy network (because the distribution of costs and benefits was uneven since it appeared as doubtful that industry and dealers would actually forego profits), it comes close to such an experience. This has certainly been facilitated by the fact that the sector is highly concentrated (in terms of companies as well as geography) so that the number of actors involved was limited, and the effects of certain measures were predictable, that is the actual outcomes came close to the intended ones. It is therefore not really surprising that other sectoral chambers which deal with more differentiated and dispersed industries have not been that successful. Nevertheless, given the past experience of mutual mistrust between all actors involved, it was not necessarily to be expected that the venture would succeed in the car

industry. If followed the pattern macroeconomic turnaround (opening of the market) which enforced microlevel adjustment, which in turn contributed to developing a basic consensus at metalevel, thus creating a crucial precondition for joint problem-solving at mesolevel.

Third, some federal states and city governments have recently shown a substantial capability of stabilizing the local economic environment and stimulating local production activities, thus contradicting the traditional logic of action outlined above. This has been most prominent in the Northeastern State of Ceará where the State government (after having fired a lot of redundant employees who had got their jobs due to the patronage system rather than personal qualification and after having rehabilitated public finance) started public purchasing programmes to simulate local industry (Amorim 1994). Another example has been the city of Curitiba where a well-developed local infrastructure and a solid financial position serve as a base for local initiatives to stimulate new industrial activity, *inter alia* in fields like the software business.

Fourth, there is some evidence (albeit so far undocumented) that business associations are changing in profile, venturing to offer services for their member firms. In the State of Santa Catarina, for instance, the Federation of Industries has started to organize the participation of local firms in international fairs. It also engages in awareness building and information dissemination, for example on things such as new manufacturing practices or ecological product requirements in the export market.¹⁰

All these factors and experiences indicate that changes are underway in Brazil. Societal actors are experimenting with new kinds of governance, and the results seem to be encouraging. Nevertheless, it will take quite some time, not only for structures to change, especially to reshape the relationship between the executive and the legislative branch of

10 Verbal communication in interviews with business association executives in Florianópolis and Blumenau, May 1993 and March 1994.

public funding agencies; reputation and career perspectives were dependent on the peer evaluation inside this circle, not on things like successful cooperative links with firms.

4.6 Deficiencies in policy-making on the local and state level

Industry tends to be clustered in Brazil, that is at a reasonable level of disaggregation in terms of industry classification a substantial number of companies of a particular industrial branch appear to be located in a restricted geographic area, mostly within a part of a federal State. For instance, the production of women's shoes is concentrated in the Sinos valley in Rio Grande do Sul, the production of men's and children's shoes in the interior of the State of São Paulo (around Franca and Birigüi, respectively), the production of ceramic tiles in the south of Santa Catarina, the processing of chicken meat in the west of Santa Catarina—not to mention the concentration of the automotive and the capital goods industry around the city of São Paulo (or, for specific political reasons, the consumer electronics industry in Manaus and, for technical as well as political reasons, the petrochemical industry in Cubatão, Camaçari, and Triunfo). As has been shown in the case of the shoe industry in the Sinos Valley, the characteristic feature of clustering is not only the geographic concentration of firms but especially the emergence of a network of specialized suppliers, capital goods firms, and services, as well as a certain level of political organization (Schmitz 1993). Therefore, in terms of meso policies industry does not necessarily rely on the central government, and the disorganization on the federal level may even stimulate joint action and policy initiatives on the local or regional level. Thus, systemic competitiveness may emerge on the local or regional level long before any such development of the national level.

However, regional initiatives are facing two serious problems. First, policy approaches that seriously aim at problem-solving do not form part of the traditional role definition of politicians and bureaucrats on the local and regional level. This is

not only true for the less-developed Northeastern and Northern regions, but especially for the Southeast and the South. Local politics are strongly based on clientelism. Rivalry between competing local oligarchies is strong, and mutual trust tends to be low. Policy initiatives that are being launched by one key figure often face fierce resistance on the grounds that his rivals presume that the main goal of any given initiative is to underline political ambitions. This logic is one element which explains the extreme orientation towards approaches that produce immediately visible results. Any other approach that would require a certain degree of consultation between different political actors simply is not viable.

Second, as long as the division of responsibilities between central, regional, and local government is not clearly defined, policy initiatives on the regional or local level are under the permanent threat of being thwarted by central government interventions—be it that the central government changes its mind and starts to pursue a competing initiative on its own, be it that the central government launches some other kind of policies that undermine the regional or local policy formulation potential, e.g. by abruptly changing the rules of the game in foreign trade. Since political actors on the regional and local level know about these possibilities, it is probable that they are going to anticipate this in their activities, and that means that their initiatives are going to be very limited in their ambitions, in the profile they keep, and in terms of the financial resources involved.

4.7 Why systemic competitiveness may emerge nevertheless

It seems that the prospects for systemic competitiveness to emerge in Brazil, at least anytime soon, are bleak. However, there are also a few examples that may indicate that profound changes are actually underway. First of all, there was the voluntarist shock of the Collor government that pushed through an opening of the market against various political actors in 1990, thus changing profoundly the incentive structure for firms. Today, Brazilian industrial firms by and large

Things have become worse after 1990 (Holanda 1993). The Collor administration tried to implement a public sector reform that amounted to little more than arbitrarily closing down some State agencies and firing employees. In fact, the government failed to achieve the latter since the constitution had established a job-for-life guarantee for all public servants employed for more than five years. What the government actually achieved was to cut the real wages, undermine the morale of the employees and stimulate many of the more capable among them to look for better paid, more stable jobs elsewhere (for instance, as professional staff of the Congress). Therefore, the technical capability of the public service to formulate, let alone implement, policies has decreased. This is particularly true at the middle level of the public service.

4.5 The absence of a national system of innovation

In the past, the prevailing incentive structure did not stimulate innovative behaviour, at least not in the way it is normally understood in industrialized countries. This is not to say that Brazil was a stationary economy with no technical change at all; the contrary has been documented. However, the larger part of technical change followed the typical pattern of latecomer industrialization where firms try to master technologies that have been developed elsewhere, try to adapt them to their needs and possibly try to improve them so that they fit better into the local environment. 'Typical R&D efforts would be determined by the need to use different raw materials, scale-down (to smaller) plant size, diversify the product mix, change the product design, use simpler, more universal, less automated and lower capacity machinery, stretch out the capacity of existing equipment, etc.' (Teitel 1987, 109). This kind of activity does not mainly require intra-company R&D but rather process engineering activities.

In the closed market environment, firms felt little pressure to extend their technological effort beyond this kind of activity (Dahlman and Frischtak 1993). With the degree of competition

being low, they had little incentive to introduce truly innovative products or to look systematically for radical improvements in the production process. There were only few exceptions, like the aircraft industry where the Brazilian firm tried to compete at the leading edge of one segment of the world market for commuter planes, or in oil exploration where the internationally available know-how on deep water exploration apparently was limited, or in the production of alcohol fuel, which simply did not exist anywhere else. In these cases, firms have set up a systematic R&D effort and have also cooperated with universities and research institutes. In most other industries, however, firms did not have R&D departments. They are an important feature in the organization of R&D cooperation with external agents since they form the major recipient structure for the internalisation of research results from external sources. In fact, as a rule firms did not confront problems, challenges and opportunities that would have made it necessary or advisable to look for research results or external research support.

Thus, researchers in universities and research institutes had to have the impression that there was little potential demand for their results in industry. Yet, this was only one reason for the clear separation between research and industry. Other reasons were (Castro 1989)

- the easy availability, particularly in the 1970s, of research funds from public financing institutions which gave the emerging scientific community a lot of space to define research priorities according to their personal interests;
- the research ideals that PhDs returning from abroad brought with them, leading them to strive for academic reputation rather than application of their research results; they often also oriented their research so that it fit into the line of activity of their foreign alma mater rather than domestic priorities;
- a certain degree of introspection that emerged inside the science system since the early 1970s, where communication mainly took place inside a circle made up by people from research institutes, universities and

market (especially in terms of cheaper and better quality inputs). Others oppose it fiercely. Since the corporatist system which was introduced in the 1930s is still in place in this sphere as well, both types of firms are members of one and the same business association which makes it correspondingly difficult to define a political standpoint on any given issue (Mathieu 1991). So far, there have been only few attempts to establish new business associations according to common interests. This is due to the fact that the costs are high since their members have to pay both the compulsory contribution to the corporatist association and the fees of the new association, whereas benefits are uncertain and the temptation to free-ride is big. This situation makes it difficult for the government to build reliable relationships with the business community.

4.3 Mistrust between firms and government

Government-business relationships suffer from a high level of mistrust on the side of the latter. This is due to various experiences:

- the change in the foreign trade regime that was unilaterally imposed by the government in 1990,
- arbitrary and frequent changes in the more specific rules that govern the business environment (in taxation, regulation for foreign exchange or financial transactions, etc.) and cause high transaction costs;
- arbitrary interventions in factor markets, e.g. regarding the level of real interest rates or nominal or real wages;
- the limited and deteriorating technical capacity of the government bureaucracy which at times leads to unreasonable or peculiar policy measures;
- the unpredictable outcome of the bargaining between government and legislative;
- the low level of transparency of the budget process;
- corruption.

Therefore, industry has been increasingly sceptical regarding any kind of government intervention, even towards those interventions that were meant to support the firms' adjustment. This was one reason why policy initiatives that were meant to add the carrot to the stick by and large had a limited impact:

- A programme on industrial competitiveness (PCI) announced in 1991 never got off the ground.
- A programme for technological capability building (PCT) announced in 1990 was passed by Congress only in 1993, and its main instrument, fiscal incentives for R&D, has little effect in a situation where company profitability depends mainly on the details of the design of macroeconomic stabilization efforts.
- A programme to raise consciousness regarding quality (PBQB) seems to have had some (albeit apparently limited) effect, mainly contributing to a trend that was underway anyway (PBQP 1992, 17).

These programmes appear to suffer from having been formulated in an isolated way and based on the experiences of advanced industrial countries. Their formulation was not based on a broad consultation process with the prospective recipients of incentives; rather, it replicated the traditional top-down approach to industrial policy.

4.4 The high level of disorganization in the public bureaucracy

The Brazilian public service has always been very heterogeneous in terms of effectiveness, efficiency, and accountability. The absence of transparent recruitment procedures, predictable career paths and personnel stability and the political mechanism of patronage reinforced each other, thus minimizing the longer-term orientation and the personal commitment of the employees (Evans 1989). Certain sectoral agencies and institutions like the National Development Bank (BNDES) were the exception from the rule.

industrial and technological development. Yet, their legitimacy is also based on successful pork-barrelling. This has to do with the structure of the electoral system: There are open, State-wide lists, and the citizens can elect whichever candidate they find appropriate (Mainwearing 1992). Typically, this means that a candidate will campaign within a certain region inside of a given State in order to raise the necessary votes there. Therefore he is dependent on satisfying the local clientele. This has two implications. First, party coherence is low as the parties do not have to set up ranked lists, and since most parties have a limited capacity to support their candidate. In fact, politicians frequently change parties or set up new ones. Consequently, there is no *ex-ante*-reason why congressmen should follow any fraction discipline. Second, the executive finds it difficult to build a reliable base in Congress. Even trying to build an *ad hoc* coalition between fractions to support a given policy initiative is often no viable option. Rather, the executive (or its 'leader' in Congress) has to find support from a sufficient number of groups of congressmen which are typically led by one of the leading political figures in Congress.

The mutual blockade between the executive and the legislative branch of government has been a crucial factor in delaying⁸ the macroeconomic stabilization of the Brazilian economy which is a key prerequisite for successful mesopolicies. The government literally had to buy support in congress, and the congressmen had to channel funds to their constituencies. Both factors contributed to the rising public deficit that became the single most important reason for the explosion of the inflation in the second half of the 1980s and the early 1990s.

4.2 The persistence of traditional corporatist structures

The internal reorganization of interest groups which is an important pre-condition to enable their representatives to take commitment in policy networks has only started. So far, the relationship between the State and major societal groups is largely organized in a way that makes it difficult for the State to forge alliances and build networks. In this respect, sorting political actors along lines like left versus right does not help much. The opening, deregulation and destatization of the economy faced resistance on the left and on the right, and probably even more on the left than on the right. This has to do with the fact that the largest federation of trade unions, CUT, which may represent as much as 70 per cent of formal sector employees, is particularly strong in sectors that represent the core of the traditional statist development model, like Petrobrás and the petrochemical industry, and in sectors that gained from the crisis of the 1980s, that is the public service and the banking sector which both expanded enormously.⁹ Therefore, despite its leftist rhetoric CUT actually is part of those forces that at least want to slow down opening and liberalization and also have a somewhat ambiguous position regarding economic stabilization. Also, CUT is in a difficult position regarding the structure of the system of representation itself. On the one hand, it would like to see the corporatist system where 'Labour Courts' settle wage disputes dismantled. On the other hand, CUT's member unions gladly accept the money they receive through the compulsory contribution of the workers (*imposto sindical*).

On the antagonistic side, industry has also found it difficult to develop clear political positions. This has to do with the fact that interests diverge vastly. Many firms hope to benefit from an opening of the

8 To say 'delaying' rather than 'inhibiting' implies that the 'Plano Real', the stabilisation programme that was launched in December 1993 and gradually introduced until July 1994, is going to succeed in reducing inflation. This appeared to be a reasonable proposition at the time this paper was completed (April 1995).

9 Over the 1980s, the number of central government employees grew 'by about 150 000 or roughly one third of its level at the beginning of the decade' (World Bank 1991: 123). The share of the banking sector in GDP grew from five percent in 1970 'to an average of 13 percent by the end of the 1980s' (World Bank 1994: xiv).

competitiveness. It is even more dramatic is that, at first sight, a total lack of systemic competitiveness seems to mark the situation in Brazil. It appears that not just a few factors are missing but rather a number of factors interact in inhibiting the emergence of systemic competitiveness:

- the disarticulation between the executive and the legislative branch of central government;
- the persistence of traditional corporatist structures;
- the mutual mistrust between State and societal actors;
- the absence of anything like a national system of innovation;
- the high level of disorganization in the public bureaucracy;
- the low propensity to develop creativity in policy-making on the local and State level.

Whereas the first three factors reflect severe problems on the meta-level, the last three point at negative interactions between meta- and meso-level. Nevertheless, there are, at second sight, also some indicators of profound change—a higher-than-expected level of responsiveness to new challenges inside firms as well as the emergence of new governance patterns in some spots.

4.1 The disarticulation between the executive and the legislative branch of central government

The president appears to be the central figure in Brazil's political system. He is popularly elected, and presidential elections do not necessarily coincide with parliamentary elections. Lamounier (1993) has described the system as a plebiscitarian presidency where the president receives a mandate to pursue (and is often expected by the electorate to actually implement rapidly) fundamental political changes, and the electorate expects him to implement them without delay. However, the

Brazilian political system has accumulated various mechanisms of checks and balances that curtail the president's capacity to govern autonomously. In the 'Old Republic' (before 1930), the leaders of some federal states (São Paulo, Minas Gerais, Rio Grande do Sul) were powerful enough to challenge the president, and the situation has changed only partially since then. After the end of Getulio Vargas' dictatorship in 1945, the congress rapidly dismantled certain institutions that had contributed to strengthen the executive power (Skidmore 1967, 34 f). The military had always played an important role in politics, even in the democratic phase from 1945 to 1964, and it did not really come as a surprise that it toppled the civilian president in 1964. But even the military presidents saw their governing autonomy circumscribed by the necessity to mediate between conflicting factions of the military and to get political support from regional oligarchies (Skidmore 1988). After the smooth transition to civilian rule in 1985, the congress again succeeded in extending its responsibilities. Therefore, the president has to strike bargains with the congress, the governors of federal states and the military in order to get his policies implemented.

Over the recent years this has proved to be particularly difficult with regard to the congress. In fact, a system that was meant to establish checks and balances has largely led to a blockade of the political process. This is due to the distorted representative structure of the congress, the large number of parties and low party discipline, and the prevalence of clientelistic behaviour, all of which make it difficult for the executive to organize a reliable political base in the legislative. In the congress, the Northeastern and Northern states are clearly overrepresented. This is most obvious in the Senate where each State is represented by three senators—be it the State of São Paulo with half the industrial product and a fifth of the population, or Amapa with hardly any economic importance and population. But it is also true for the Chamber of Deputies (Rosenblatt and Novaes 1993). The political behaviour of congressmen from the Northeast and the North is largely shaped by their efforts to channel government funds to their local constituencies, whereas congressmen from the Southeast and South may take an interest in

- reciprocity, or a just distribution of the costs and benefits of a joint decision (or a given problem solution);
- voluntary restriction of each actor's freedom of action because it is accepted that each actor has a legitimate claim that his interests be respected.

Policy networks differ from traditional corporatism in that the role of the State has changed: rather than organizing private interest and arbiting between corporatist groups which hardly interact among each other, representatives of associations interact among each other and with State bureaucrats on an equal basis. Policy networks are also different from the 1970s brand of European neo-corporatism which basically involved the central State government and the peak organizations of capital and labour. Yet it is difficult to find a profound difference between 'meso-corporatism' and policy networks: both terms describe arrangements that used to have a certain level of institutional (albeit often informal) stability and a set of (albeit often tacit) rules that govern the interaction process.

Policy networks tend to be organized on a sectoral basis, dealing with fields like science policy, technology policy, or health policy; and they tend to be embedded in political structures where there is some higher level that may intervene in case a policy network runs astray. The State can, for instance, stimulate the build-up of local or regional policy networks that set out to formulate an industrial strategy. It can make sense to support such efforts financially as long as this support is linked to performance criteria. On other levels, for instance a policy network for technology policy on the national level, the threat that the state might unilaterally devise measures that run counter to the interests of the parties involved is an important stimulus for the proper functioning of policy networks.

To sum up, building systemic competitiveness is based on four interrelated elements:

- strengthening market forces by reducing overregulation and creating stable framework conditions for macropolicy;
- unburdening the government and increasing government efficiency by strengthening market forces and delegating control tasks to nongovernmental actors, interlinking public and private actors, strengthening subsidiary principles and social solidarity, and building sectoral policy networks;
- strengthening the self-organization capacity of societal actors as the precondition for the emergence of solid patterns of social organization and complex forms of governance;
- integrating the market with effective institutional systems, with an eye to optimizing economic development potentials and offsetting the destructive tendencies of a market economy (social and environmental policies).

Structural change towards competitiveness based on a new model of governance can only take place stage by stage. Experience shows that, in the long term, more complex forms of interaction and intervention at meso-level are successful only if radical change on the basis of sound macropolicies has already been introduced. Social frustration can only be avoided if key actors explain the complex nature of the change to society, something that was not done in Latin America until the late 1980s. On the other hand, various experiences show that overcoming minimalism is the basic prerequisite for sustained competitiveness and the improvement of the welfare of the population.

4 Systemic competitiveness: a realistic perspective for Brazil?

At present, the governance capability appears severely limited in Brazil. Therefore, it would be out of place to formulate a broad set of policy measures that would have to be implemented to support the industry in its struggle for more

may establish a positive-sum game. Only a relatively autonomous government is able to orient its activities toward overall social and economic interests. Transparency and accountability are crucial. Autonomous functional subsystems are based on a clear-cut separation of government, industry, and societal actors. They may then be further developed by intrinsic learning processes, flexibility and responsiveness, and by dialogue and efforts to search cooperatively for all optimal solutions involving government and societal actors. This may occur on the national as well as on the regional and local level. In fact, traditional governance structures often implied a high level of centralization of political decision-making. Redefining the role of state may include a revision of the division of responsibilities between central, regional and local governments, and re-distributing tasks and funds to the latter. Systemic competitiveness requires fundamental changes in the national environment, especially in fields like trade policy and exchange rate policy which are crucial in determining the incentives that economic actors face. Yet, it will often be created on the local level where the actors involved find it easier to identify common interests and to devise measures to improve both firm competitiveness and social welfare.

3.3 New forms of governance

Aside from the forms of governance already prevalent in societies organized along the lines of market economies—hierarchical coordination and steering in firms and public institutions, market-like coordination among firms, and hierarchic governance of society by government -, network-like forms of organization are emerging (Powell 1990), in particular at the meso-level, which are characterized neither by simple market allocation (competition and price) nor by centralist governance mechanisms (hierarchic control and State interventionism).

The predominant discussion in the 1980s of market vs government overlooked these innovative forms that were involved in the shaping of social structures. They are based on a combination of

market, government and a variety of forms of self-coordination in the shadow of the market, the shadow of hierarchies, and in self-organizing networks (Scharpf 1991). This view of increasingly differentiated forms of social organization and governance surmounts the classical dichotomies of market versus government and of total autonomy of decentral actors (liberalism) versus totally integrated society (socialism).

Social processes of searching and learning should not be limited to strengthening the market and paring down the scope of government. Rather, they should try to involve important societal actors. The emergence of policy networks is due to:

- increasing differentiation of societies and the increasing complexity of problems;
- the diminishing viability of hierarchical governance;
- the increased technical and organizational competence of societal actors, especially when it comes to sectoral policies;
- the benefits that arise from information-sharing which improves problem-definition and proposed measures;
- the improvement of the prospects for policy implementation due to the presence of the addressees in the coordination networks.

Successful policy networks are based on the following core elements (Mayntz 1991, 16):

- autonomous collective actors capable of internal conflict resolution;
- trust and commitment to fair exchange;
- orientation towards a substantial outcome (problem-solving, beyond minimum consensus);
- joint decision-making based on information-sharing;

public actors; and corporatist structures with a rent-seeking orientation block any attempt of joint problem solving, that is policies that go beyond the smallest common denominator.

3.2 Governance for industrial competitiveness: demands on the meta-level

The control and governance capacity of government and collective problem-solving arrangements, that is well-developed structures on the meta-level (Esser *et al.* 1993), are a crucial precondition to optimise performance potentials at the micro-, macro-, and meso-level. Once this is present, it will be possible to mobilise social creativity. Until recently, however, most developing (as well as, of course, socialist) countries were characterized by centralized political decision-making processes and a bureaucratic, inefficient government apparatus with a low level of governance capacity. Often, this was even overlaid with rentist-corporatist structures which allowed privileged groups to effectively realise their particularist interests (Kaufman 1990, Cavarozzi 1992). These power structures corresponded with forms of social disintegration and fragmentation which were characterized by the exclusion of broad segments of the population as well as by political and social polarisation. Economic modernisation and the development of systemic competitiveness cannot succeed in the context of such social structures.

The structural adjustment programmes of the 1980s did not take into account that developing countries are by definition characterized by weak markets and weak firms, an omnipresent and at the same time weak government, and weak societal actors. The tendencies toward social disintegration are further exacerbated if macroeconomic reforms fail to establish regulatory and governance capacities (government reform, formation of complex linkages between strategic actors) and the requisite social structures. Systemic competitiveness cannot emerge without social integration. Building systemic competitiveness is thus a social transfor-

mation venture that goes far beyond correcting macroeconomic framework conditions.

Against this background, a basic social consensus on the direction of the changes aimed at is crucial to a reorientation. However, societies cannot choose directions randomly; the key actors have to accept the world market as a framework of reference. This does not necessarily imply a high export ratio; it rather implies that firms should aim to get close to international quality and efficiency standards. Moreover, medium-term orientations and visions are important to assert future interests against current interests and generate stable expectations. If the effort to develop them fails, the required structural change will be deferred, as was the case in many Latin American countries in the 1980s, thereby prolonging the process of social disintegration; and weak societal actors who are unable to articulate their interests adequately will pay the bill. To overcome obstructive social structures, durable patterns of social organization and values which the societal actors share in terms of concerted action and cooperative approaches to problem-solving are needed in the medium term.

The process of social structural change involves safeguarding the autonomy of social institutions and organizations from encroachments on the part of government. The de-linking between State and trade unions, industrial associations, the scientific community and other societal actors pending in many countries can give rise to self-responsibility. This is an important prerequisite to unfold creativity potentials. The autonomous societal actors and the intermediary institutions proceed along the lines of three complementary logics. First, they optimize their institutions or firms (inward-looking orientation) on their own responsibility. Second, they represent their interests *vis-à-vis* government or other societal actors (competition). Third, they shape their own environments through cooperation and networking with public or private institutions (cooperative competition). Increasing social self-organizational competence on the one hand, and clustering and channeling creativity potentials on the other are complementary tasks.

Major groups in society must learn that safeguarding government from influential, privileged groups

Asia (Cumings 1984). However, as societies get ever more differentiated, and firms as well as other actors undergo learning processes, it becomes the other way around—in OECD countries as well as industrially advanced developing countries. Moreover, top-down approaches are unsuitable in the sphere of industrial location policy and the development of mesopolicies because the action potentials, the know-how requisite to formulate long-term policies, and the implementation capacities are distributed across a variety of governmental, private, and intermediary agencies. In the era of Fordism and highly standardized patterns of production, it was possible to successfully build vertically integrated major corporations on the basis of centralist, government-controlled industrial planning. However, one-dimensional, etatist and centralist patterns of governance are doomed to failure when the development and support of complex entrepreneurial networks and specialized institutional landscapes are called for (Best 1990).

Still, the conclusion that the State has no role to play at all is not well founded since this proposition ignores the undisputable fact that new forms of governance have emerged, initially in a number of OECD countries where government policy no longer follows the pattern of a traditional interventionist State. Rather, government acts as a coordinator, moderator and communicator in policy networks with firms and their associations, science, intermediary institutions, and trade unions. It aims at collecting and disseminating relevant information and working out joint medium- and long-term visions that can serve as points of reference for government mesopolicies as well as private initiatives (Scharpf 1991, Mayntz 1991, Héritier 1993, Atkinson and Coleman 1989). These new location policy strategies, which have emerged in a number of European (Cooke and Morgan 1993) as well as U.S. regions (Sabel 1993), differ fundamentally from the top-down approaches of traditional industrial policy, industrial planning, or investment guidance.

This is also true for late industrializers like Japan where MITI had to redefine its role after the completion of industrial catch-up (Vestal 1993), or like South Korea where the role of the State and

the type of interaction between the State bureaucracy and the private sector is undergoing profound changes. During the phase of catch-up industrialization the state clearly played a guiding role, often ruling into the firms even when it came to day-to-day decisions (Hillebrand 1991). This was based on the bureaucrats' superior planning and evaluation capacity. Over time, however, private firms (especially the big conglomerates) have increasingly developed a capability for strategic planning. A painful process started recently where bureaucrats resist giving private actors more autonomy in their decision making, let alone a bigger role in strategy formulation. Fierce struggles between private firms and the bureaucracy emerged.⁷

The development of a much less hierarchical pattern of social organization and techniques of intervention and regulation that leave the autonomy of societal actors intact in the mesodimension facilitate the governance and shaping of market processes and compensate for the weaknesses of pure market mechanism and statist planning (Scharpf 1991). These mechanisms make it possible to relieve the government's burden by shifting decision-making processes into intermediary arenas, to ensure a higher degree of information availability, to heighten the legitimacy of government decisions, and to mobilize the creativity available among societal actors by involving strategically them and their respective problem-solving capacities. They do, however, presuppose on the part of societal actors a capacity to compromise, to perform and learn, and to accept transformation. The conditions to establish this new form of governance for an effective mesopolicy are difficult in many countries. More often than not, polarization between societal actors is very pronounced, and there is no experience in communication and interaction between private and

7 In the case of South Korea this took the shape of Chung Ju Yung, founder of Hyundai, one of the four leading conglomerates, candidating for presidency in 1992. The State reacted to this by arbitrarily excluding Hyundai firms from incentives, subjecting Hyundai firms to unusually strict tax examinations and arresting Hyundai executives for practices that used to be tolerated (Nam 1994).

sion instead of the widespread pork-barrel approach to promotion aims at strengthening the strong with an eye to building, as rapidly as possible, dynamic industrial centers and efficient industrial sites, even though this may imply a certain degree of negligence of less developed areas.

Under the current conditions in adjusting economies it is possible to distinguish three variants to define priority sectors for targeting:

- As a result of altered economic framework conditions, new export-oriented fields of specialization have emerged during the process of change, often initially based on locational advantages (e.g. in Chile exports of fruit, fish, and timber). Their commercial environment must be developed systematically in order to support the difficult search and learning processes which companies are facing. In this case, mesopolicies that support and stimulate the build-up of trade and technology information systems and training facilities can follow and complement market selection processes.
- Based on an assessment of the potential of domestic industries to adjust and restructure (through evaluation, identification of efficient sectors), an attempt should be made to 'strengthen the strong'. If this is neglected, the process of rapid opening up to foreign trade can even lead to the destruction of segments with a high development potential. 'Non-discrimination' between definitely obsolete industries and potentially competitive industries entailing a lack of policies to support the latter is expensive in both economic and social terms. For example, research in Poland has shown that rapid trade liberalization has led to the collapse of industries which appeared to be fairly competitive (Brunner 1993). Due to managerial deficiencies, these industries failed to find access to Western markets after the rapid collapse of their traditional markets in the East. Export credits and other active export promotion measures might have ensured the survival of these industries. Such forms of destruction of productive capital can be prevented by assessing firms' capabilities, targeting sectors, and selective mesopolicies.

- The most demanding, but not necessarily most promising, task is the search for future economic fields in industries with a high growth and employment potential and the development of an anticipatory structural policy. In this area, 'windows of opportunity' (Perez and Soete 1988) are not open all the time; and even if they open, a lot of preconditions have to be met if entrepreneurs are to jump successfully through those windows. This form of targeting promises success only once economic consolidation has been achieved and there is a successful track record of meso-level activities, so that entrepreneurs can trust in the State's commitment to mount a sustained effort to support their ventures. Such kind of policy should be based on an intensive dialogue between firms, government, and the scientific community.

3.1 Rising demands on governance on the meso-level

The competitiveness of firms rests on the effectiveness and efficiency of industrial sites, or, in economic terms, on the density of externalities, i.e. the intensity of interaction between firms and with universities, training institutions, R&D facilities, technology information systems, private consultancies, trading companies, financing institutions, and the like (Porter 1990). The demands on the local, regional and national level to create and support the business environment tend to grow; this applies to demands on business associations and other non-governmental actors as well as to demands on the State on all these levels.

Although the dogma which stipulates that government is obliged to assume a strictly subsidiary role *vis-à-vis* market processes is inadequate, the neo-liberal critique of the traditional ways of government intervention is basically correct. The idea that government alone, as a kind of central control centre of a society, can selectively direct technological and economic processes presupposes that government bureaucrats are more capable and better informed than other actors in society, including firms. This has been the case in some latecomer countries, most impressively in East

technology, and products, and the optimal character of decentrally organized decision-making processes. They reject active, anticipatory and/or accompanying industrial and technology policies. It was only during the course of ill-fated adjustment programmes that the political dimension of structural adjustment received more attention (Haggard and Webb 1993). But again, emphasis was placed on the prospects of implementation and sequencing of macro-level reforms rather than on meso-level policies.

In fact, a number of developing countries succeeded within the framework of structural adjustment programmes to stabilize economic framework conditions, thus revealing the pivotal role played by the once neglected field of macro-economic policy for the development of sustained competitiveness. But the expected reactivation of their economies often failed to materialise. The reason is that the support structures that distinguish competitive industrial sites have not been shaped and, to make things worse, in some cases important locational factors were further weakened (e.g. education and R&D) by the adjustment measures targeted on budget consolidation (Klitgaard 1991). Thus, instead of stimulating industrial development, the conditions necessary for sustained competitiveness were further undermined.

Industrial competitiveness calls for a lasting improvement of locational factors, and this in turn calls for the active shaping of structures between the macro- and the micro-levels, that is the meso-level. Developed countries and NICs improved their position in the international economic hierarchy if they succeeded in structuring the institutional setting of industry specific services situated between macroeconomic conditions and micro-actors. Their experience has shown that a State which acts competently can correct market failures and shape the supply side of industry on the basis of:

- a specific industry and trade policy which links support and protection for companies to clear performance targets;

- a technology policy which encourages companies to engage in R&D and establishes technological institutes focusing not on international leading edge developments but the most significant bottlenecks in the national technological system;
- labour safety legislation and suitable framework conditions for the self-regulation of industrial relations to support the establishment of modern structures in companies;
- an education policy which provides both a broad basic education and further technical and scientific training tailored to the needs of society.

Mesopolicies, in particular the development of a material and non-material industrial infrastructure (the development of an industry cluster-related infrastructure to optimize the external economies of companies; cluster-related technology policies etc) should focus on a number of main areas (concentration of existing resources) to speed up the process of world market-oriented specialisation. Michael Porter (1990, 78) comments on the significance of developing specialization advantages as follows:

‘Contrary to conventional wisdom, simply having a general work force that is high school or even college educated represents no competitive advantage in modern international competition. To support competitive advantage, a factor must be highly specialized to an industry’s particular needs—a scientific institute specialized in optics, a pool of venture capital to fund software companies. These factors are more scarce, more difficult for foreign competitors to imitate—and they require sustained investment to create.’

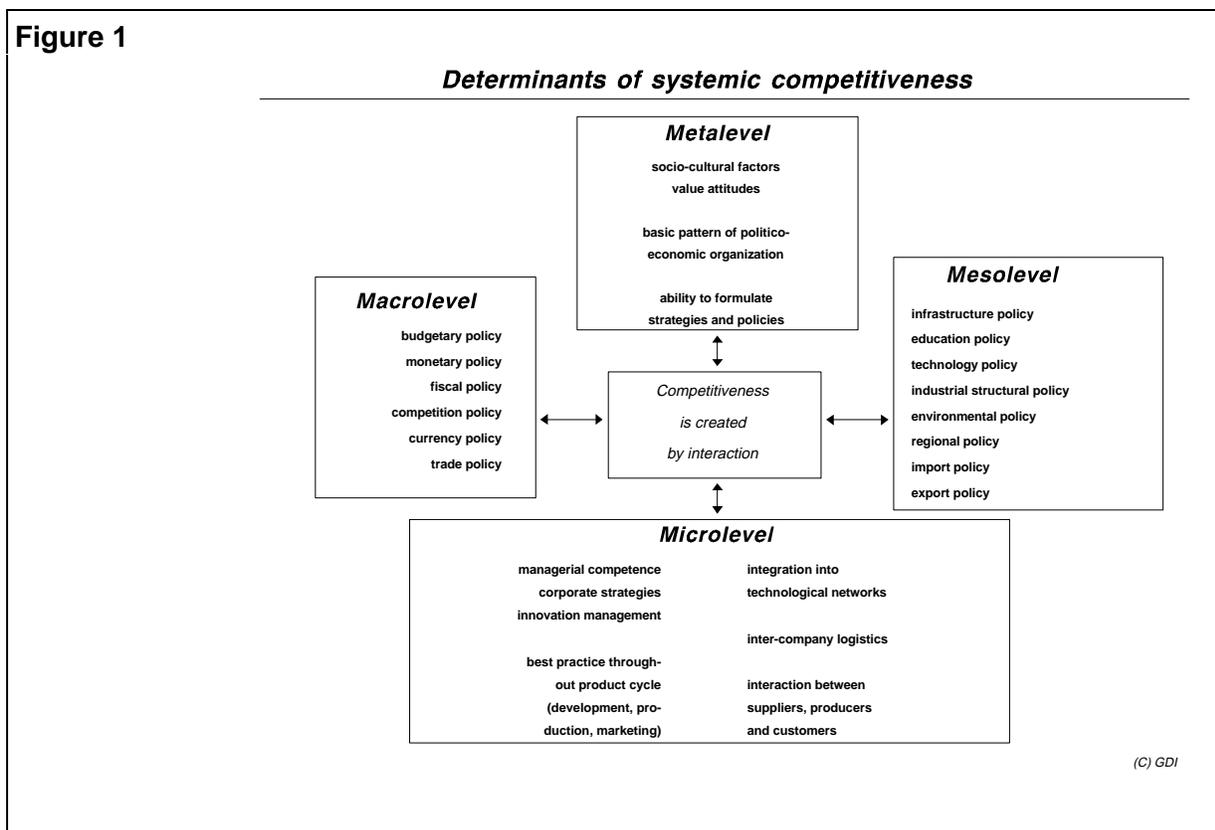
Therefore, apart from and beyond general innovation-friendly framework conditions, the development of dynamic competitive advantages requires specific, selective mesopolicies. Going beyond ‘generic’ policies, selectivity in the mesodimen-

These are serious shortcomings in a world where competitive pressure is rising, and where some societies succeed in creating governance patterns that are capable of shaping an environment that stimulates and supports the firms' quest for competitiveness. We refer to this pattern as one of *systemic competitiveness* (Esser *et al.* 1993). By using the term *systemic* we want to point out several factors. First, a firm will generally not become competitive on its own, that is without a supporting environment of suppliers and production-oriented services as well as the competitive pressure of local competitors. Secondly, an environment that sustains competitiveness is rooted in the way a society is organizing itself, i.e. in its general and specific institutions. Thus, *systemic* refers to externalities that often are deliberately created within specific governance structures. Third, we maintain that the State has an important role to play in industrial development and restructuring. However, we start out from the experience that autocratic, hierarchical modes of governance are becoming obsolete. New forms of governance are emerging that are based on a new

kind of interaction between State and societal actors, typically in horizontal networks. Fourth, there are strong interrelationships between four different levels, that is the micro-, meso-, macro-, and meta-level (Figure 1). Meso-level means the space between the micro-level of the firm and the macro-level of the economy as a whole, that is organizations, institutions and policies that are specific to and necessary for certain segments of industry. The introduction of the meta level refers to issues like the the basic governance structure of a society and its ability to build a basic consensus and to formulate strategies.

We add thus two levels that were largely neglected in the the framework of structural adjustment which has dominated policy making since the 1980s where macroeconomic reforms were perceived as not only a necessary but indeed a sufficient condition to stimulate microlevel restructuring, thus enhancing industrial competitiveness. Neoliberal theories of allocation and foreign trade emphasize the importance properly functioning international markets for capital,

Figure 1



mainly on external financing. This strategy collapsed because, first, there was little left to be substituted and because, second, from 1982 onwards foreign creditors were not willing to throw good money after bad (Batista 1992, Moreira 1993). Yet even in this situation that in political terms was marked by the smooth transition from military to civilian rule it was evident that no serious discussion on the true roots of the crisis started. The striking feature of the civilian government that took office in 1985 was not that it was not able to maintain fiscal discipline; after years of crisis and oppression no newly elected government would have been able to resist demands from those parts of society that had been neglected under authoritarian rule. Rather, it was the total absence of any discussion about medium- to long-term development options that seriously would have taken into account the changed international conditions and the limitations of the inward-oriented development model. The roots of the crisis were often sought in the conspiracy of the industrialized countries that were not willing to relieve the debt burden; and the way out of the crisis seemed to lie in redistributive policies that would raise the purchasing power of the poor majority of the people (Furtado 1984).

It was only in the late 1980s that Brazilian scholars began to perceive the underlying reasons for the East Asian development success and that important institutions like the National Development Bank (BNDES) started to formulate concepts that would have introduced fundamental changes into the trade and development regime (BNDES 1988). At the same time, however, the congress enacted constitutional rules that excluded foreign firms from areas like mineral exploration, continuing the nationalist, inward-oriented and xenophobic⁶ orientation; and the government proved to be unable to implement anything, let alone radical changes in the industrialization regime. Due to the economic crisis, its financial situation became increasingly critical, and therefore it was no longer

able to satisfy the demands from the societal groups, thus seeing its legitimacy and support and its governance capacity vanish. The political constellation changed from muddling through to getting stuck.

The situation did not improve substantially when a new government took office in 1990 even though it made a crucial move: it started to phase out tariff and non-tariff trade barriers, adopting a step-by-step approach in exposing domestic firms to external competitors, thus enforcing a fundamental change of course in the framework for industrialization. It was able to do so for two reasons. First, it could change the rules governing foreign trade at will, without having to involve the congress. Second, business associations were internally divided over this issue and therefore not able to establish firm resistance against the move (Weyland 1993). Apart from this move, however, the governability of the country was constantly decreasing as the erosion of traditional lines of communication between the State and social groups added to the stalemate between the executive branch of government and the legislature; the capacity of the latter to contribute to policy formulation was severely circumscribed by the proliferation of parties and low party discipline, thus making it virtually impossible to establish a sustainable coalition in congress, and by the prevailing clientelist mode of securing legitimacy (Mainwaring 1992). The government was, at least until early 1994, neither able to stabilise the economy, nor did it succeed in establishing policies to support the private firms that were under severe pressure to adjust due to the change in the trade regime.

3 New governance structures to foster industrial competitiveness—general considerations

6 This xenophobia used to co-exist peacefully with a regulatory framework that was fairly open to foreign direct investment, especially in those areas where national firms were not able or willing to operate.

What emerged under the conditions of import substitution was a very peculiar political system that did not fit neatly into analytical concepts that had been developed against the background of the experience of the industrialized world. The missing transition in political hegemony from 'traditional' to 'modern' elites was only one feature that distinguished these countries from advanced industrialized countries. What on the surface appeared to be a democratic system was in fact a camouflaged version of oligarchic rule, and reappeared as such after the end of military rule in 1985 (O'Donnell 1988). What appeared to be authoritarian military rule was based on a delicate balance between different factions within military and between military and traditional oligarchies (Skidmore 1988). In terms of interest representation, elements of clientelism, corporatism and sometimes pluralism coexisted. The State was both an instrument of the élite to enrich itself and the promotor of industrial development.

In any case, it was a structure that was characterized by a high level of State intervention into economic and other societal spheres. This structure has been described as a State-centred matrix where all kinds of demands were addressed to the State. Newly emerging political actors 'made increasing demands which were appended, in successive waves, to the pre-existing ones. These sequential and often antagonistic demands, and the conflicts they generated, tended to be negotiated within isolated arenas; that is, each actor, or cluster of actors, was linked to the State through exclusive channels' (Cavarozzi 1992, 674). What emerged was 'a pattern of accumulation of multi-dimensional conflicts and oppositions that can be characterized as one of *conflict sedimentation*. Successive and multiple layers of conflict were erected one on top of the other without developing mechanisms for settling disputes in a negotiated and orderly fashion. This is not to say that conflicts were never resolved; in fact, sometimes they were. The pattern of resolution, however, was overly dependent on arbitrary State decisions' (Cavarozzi 1992, 675). In such an environment, 'pockets of efficiency' (Evans 1989, 577) could exist, and certain state agencies could act in a very competent and effective manner. This has been shown with regard to the build-up of the car

industry in the 1950s (Shapiro 1994) and the petrochemical industry in the 1960s and 1970s (Mathieu 1991). Other examples can be found easily.⁵ However, neither did these 'pockets' link up to a network of effective agencies, nor did their experience set an example for the less effective parts of the public service. Indeed, their effectiveness was often a temporary phenomenon as it was dependent on the support and protection of the president or other high-ranking state executives.

Moreover, this conflict sedimentation structure had an immediate and a long-term negative effect. The immediate effect was that, since there was no way of finding a way to distribute the costs of development, in particular of industrial development, the State had to print money in order to cover its expenses, thus creating a high and occasionally exploding level of inflation. The long-term effect was that since the ability of government to cope with any kind of radical change or new challenges or opportunities was highly restricted, the society did not react adequately to external pressures and did not use emerging opportunities, e.g. seizing a slice of the rapidly growing world market for industrial products. In the mid-1960s, attempts to shift to a more open trade regime soon got stuck. The surge in manufactured exports that started in the early 1970s was stimulated with hefty subsidies and reflected the possibility to appropriate substantial rents; the basic model of inward-orientation remained unchanged.

The inability to change course became even more obvious in the 1980s which was a period of crisis in economic and in political and strategic terms. The government reacted to the second oil price shock in much the same way as it had done six years before, that is trying to grow out of the crisis by trying to deepen import substitution, based

5 Further examples include the agricultural research and extension service in the 1970s (Goldin 1990), or the National Development Bank (BNDES) that maintained a fairly good reputation, especially compared to development banks in other developing countries, or indeed the Special Secretariat for Informatics that - contrary to the obvious incentives - at least succeeded in maintaining a reputation of not being corrupt.

was only in the 1950s that the support for this kind of policy grew in the major Latin American countries. Apparently, the theoretical work of CEPAL that provided the proponents of national industrialization projects with a conceptual framework has played a major role in this process (Bielschowsky 1991).

The pursuit of an inward-oriented industrialization strategy had important political implications. At the outset, there existed only a small and politically unimportant industrial bourgeoisie. In the initial stages of the industrialization process it remained heavily reliant on State support, and it was only after the industrialization process had gained momentum that the emerging industrial bourgeoisie started to articulate itself. Its ability to do so, however, was circumscribed by several factors. First, State bureaucrats wanted to maintain their guiding role in the industrialization process and therefore tended to resist attempts of the private sector to gain autonomy. This was particularly true in the 1970s when industry became increasingly critical of the growing weight of state firms (Lamounier 1991).

Second, corporatist structures had been introduced where industrial firms were organized according to trade, but not necessarily according to common interests. Therefore, even if firms wanted to assume a political role it was often difficult for them to develop a common position within the corporatist organization. This was particularly the case in industries with a small number of big firms that enjoyed preferential treatment from the State (like subsidized credit), whereas the majority of small- to medium-sized firms had to struggle with different problems, like for instance getting access to any credit at all (Frischtak and Atiyas 1990). The result often was that individual firms or small groups of firms built up a special relationship with a particular State agency in order to circumvent the problems of joint interest formulation inside the corporatist entity. This, however, raised all kinds of problems which are typical for personalized instead of formalized relationships, intransparency, unclear rules, arbitrary decision-making, and so forth.

Third, the industrial sector typically was not in a position to gain a hegemonic position inside the society even if the industrial development itself was fairly dynamic. Rapid growth of industrial output usually did not overcome one of the major bottlenecks that such countries tended to experience, that is the shortage of foreign exchange. This shortage was one of the major reasons for import-substitution policies. The goal of these policies was not to become internationally competitive as soon as possible but rather to build a local industry as soon as possible in order to save precious foreign exchange. This approach did little to stimulate domestic competition; on the contrary, tolerating a proliferation of entrants would often have collided with the goal to come anywhere close to minimum efficient scale since the local market supported hardly more than one efficiently sized firm in many industries (Fritsch and Franco 1989). More often than not, these firms attained neither the size nor did they feel much pressure to become efficient. The result was an industrial sector that remained dependent on imports (of capital goods and certain inputs) but was, due to its insufficient competitiveness, hardly able to generate foreign exchange.⁴ Traditional sectors like mining or agriculture, but also non-traditional agriculture continued to be the major exporters. This implied that rural oligarchies—due to their obvious economic weight—continued to play an important role in domestic policies.

4 To counter this argument, it is often pointed out that Brazilian industry had a fairly strong export performance since the 1970s, and achieved remarkably high export surpluses after 1983. Three arguments may qualify these undeniable facts. (a) The export performance has to be seen in the light of the availability of high export incentives which allowed the appropriation of rents for some sectors, especially cars (Pinheiro *et al.* 1993). (b) The export ratio always remained low. The export performance was due to the effort of a limited number of firms and sectors, some of them foreign owned (where the export was a function of the global strategy of the respective firm); areas like the shoe industry in Rio Grande do Sul, where the export performance was undoubtedly due to entrepreneurship (Schmitz 1993), were the exception rather than the rule. (c) The period of high export surpluses were also a period of lost opportunities since in the second half of the 1980s the Brazilian market share actually dropped in the majority of industrial branches (Batista and Fritsch 1994).

of scale, building up one-firm-industries and establishing high barriers to entry (and often to exit as well) instead of stimulating competition. Rather, the State must manage at the same time to secure competition and to support the emergence of competitiveness at the firm- and inter-firm-level. This is no easy task. Many traditional policy instruments like licensing of manufacturing capacity are hardly viable today. Moreover, the prospective recipients of State support are often not at all enthusiastic about it. Their memory of past State interventions (in terms of industrial policy, but more importantly in terms of macro-economic policies that caused turbulence) is still alive; and often these have hindered rather than stimulated their development. Furthermore, they often perceive their achievement as a personal success, that is as a result of individual entrepreneurship *vis-à-vis* hostile framework conditions, or to put it differently: as a victory over State activities that discriminated against them.³ Their confidence (let alone their trust) regarding the seriousness of the state's promotional activities is correspondingly low.

The first question is therefore not which instruments the State should use to support the emergence of competitiveness, but rather how the State can establish a policy dialogue with societal actors. In other words: before anything else, State and societal actors must establish new governance structures. This applies to necessary changes internal to each actor (for instance, business associations and trade unions) as well as to networking between them. The state has to re-establish the technical capacity to govern, to cut the clientelistic links between individual agencies and private actors, and to cut its overly detailed interventions into economic and social processes. Societal actors have to establish a certain degree of internal cohesion. This is particularly difficult in traditional corporatist circumstances where associations received their mandate from the state rather than from their members. Only then will

policy networks emerge that aim at problem-solving rather than at rent-distribution.

In this paper, I will address both of the questions mentioned above. My argument is mainly based on the Brazilian case, but occasionally it draws on experiences from other countries also. I will first analyse the political consequences of the crisis of the traditional inward-oriented development model. I will then develop a view on how a new kind of relationship between State and society may emerge and what new governance structures may look like. Finally, I will address the question of what kind of policies might be formulated by the actors involved.

2 Brazil: The end of import substitution and the erosion of governance capability

In the import substitution era, the State played a key role in industrial development. It sometimes formulated strategic plans for industrial development. It stimulated the emergence of private firms by providing them with cheap credit and sheltering them from foreign competition. It started its own firms in those sectors where private entrepreneurs were not willing or able to invest. It tried to shape the environment for industrial development by creating technology and training institutes and financial institutions.

These activities often relied on the initiative of State bureaucrats. Although there had been a certain amount of 'spontaneous' industrialization before and after the world economic crisis of 1929/32, this was limited to comparatively simple industrial activities. Local firms hesitated to involve themselves in basic, capital goods and consumer durables industries. In fact, it often took the bureaucrats a lot of persuasion and arm-twisting to make local firms move into these sectors, and they also had to overcome resistance from important actors in the domestic political arena who did not see any sense at all in building up these industries rather than importing the respective products. It

3 This has been described particularly for the case of Chile; see Messner (1993a).

I Governance in the Post-Import Substitution Era: Perspectives for New Approaches to Create Systemic Competitiveness

1 Introduction

Over the last years many developing countries have, after decades of inward-oriented industrialization efforts, opened their markets to foreign competition. In such countries industrial firms are facing a difficult time. First, firms have to face the challenge of Japanese management techniques. Japanese firms (and firms in other countries that intelligently adapted the principles of Japanese production organisation) have achieved, compared to traditional 'Taylorist' firms, a superior performance in terms of efficiency and quality, while at the same time maintaining a high level of flexibility and responsiveness. This has redefined the rules of global competition. Firms have to reorganize (if not 'reinvent') themselves in order to maintain their competitive position.¹ The capability of Brazilian firms to do so is looked into in Chapter III.

Second, whereas firms in Western industrialized countries are familiar with the phenomenon of competition from abroad, this is a new experience for firms in many developing countries. After a long period of protection (that often lasted half a century or more) they have to face the cold wind of international competition for the first time. For them, adjustment often does not mean improvement on an already good performance, but rather implies the alternative of performance leaps versus the prospect of extinction.

To make a considerable challenge even more difficult, these firms have to manage the adjust-

ment process largely on their own. This has to do with the political features of macroeconomic adjustment. More often than not, the State resorts to opening the domestic market only when it seems to be the sole alternative. Often, this will only be after a prolonged crisis that has weakened the political actors who had benefited from the market protection. The latter include not only business associations but often trade unions as well. In such a situation of deep economic crisis, attempts to manage the adjustment process, i.e. industrial policy to support firms, are likely to fail due to the exhaustion of traditional modes of governance, the erosion of the state's governance and administrative capacity, and generalized mutual distrust among political actors.

This does not mean that the State does not have a role to play in the new environment. On the contrary: Successful industrialization typically rests on various types of State support and intelligent regulation.² However, the rationale of State activity is different today. Until the 1970s, industrialization policies had to follow the principle of infant-industry protection, trying to stimulate private firms to enter into industrial sectors that had not existed locally so far, or setting up state firms in these sectors. Today, such industries are far beyond the infancy stage, having gone through learning efforts and developed a certain level of managerial competence and technological capability. In more recent times, the concept of infant industry protection applied to those emerging industries where windows of opportunity opened over the 1980s. However, these industries, like microcomputers or microelectronics, are rapidly maturing now so that the windows of opportunity have closed again, and barriers to entry are on the rise.

Contrary to the practice in the early days of latecomer industrialization, policy may today no longer exclusively follow the logic of economies

1 For an overview of the issues see, for instance, the contributions in World Development, No.1/1995.

2 See, among many others, Hillebrand (1991). For a critique of the World Bank view on the East Asian miracle that basically claims the opposite see, inter alia, Killick (1994) and the contributions in the Special Section of World Development, No. 4/1994.

Foreword and Summary

This publication summarizes the author's recent research on industrial development in Brazil. It addresses three issues: changes in governance patterns after the end of import-substitution, changing patterns in technology policy, and changing organizational patterns on the firm level as industry struggles to cope with increasing competitive pressure.

New governance patterns. Like many developing countries Brazil is struggling to upgrade its industries to attain international competitiveness. Sustained industrial competitiveness, the first chapter argues, rests not only on firms' capabilities (micro-level) and a stable economic framework (macro-level) but also and in particular on a supporting, sector-specific and specialized environment and targeted policies (meso-level) and on governance structures that facilitate joint problem-solving by State and societal actors (meta-level). The concept of systemic competitiveness is introduced to address the interrelationship between the four levels. The chapter analyzes six types of obstacles to achieving systemic competitiveness in the particular case of Brazil: the disarticulation between the executive and legislative branch of central government, the persistence of traditional corporatist structures, the high level of disorganization in the public bureaucracy, the absence of a national system of innovation, the prevailing mistrust between firms and government, and deficiencies in policy-making on the local and state level.

New departures in technology policy. The second chapter further elaborates on the observation that there is no national system of innovation in Brazil. What has emerged in the era of import substitution was hardly system and limited innovation: Apart from a few isolated cases, there was

little interaction between universities and technology institutes on the one hand and industrial firms on the other; and the firms themselves could prosper on the basis of limited innovative efforts. This, it is argued, has to do with the incentives that both sides were facing in the import substitution era.

The following part outlines what role technology policy can play in the period of transition to a more competitiveness-oriented industrial development model. It discusses different approaches to and instruments of technology policy. It addresses a number of questionable assumptions that are widely held in the Brazilian technology discussion and that make the transition to a more effective technology policy difficult. Finally, it elaborates a number of policy proposals as well as addresses the question of an appropriate governance structure (between government and societal actors, but also between different levels of government).

Intra-firm restructuring. In the early 1990s, Brazilian firms started to put more effort into enhancing their competitiveness by introducing new management concepts and investing in new technology. A survey conducted in 1991 looked more deeply into this process. In contrast to other research projects which investigated the "usual suspects", that is prominent pioneering firms in the implementation of most recent organizational patterns, this survey took a broader look into one sector, namely the capital goods industry (machine tools and heavy equipment). The survey showed that the efforts were quite uneven: the number of firms that operated anywhere close to the global best practice was limited, and many firms—most notably by far most foreign firms—had not even started to introduce new management concepts.

Berlin, June 1995

Jörg Meyer-Stamer

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Jörg Meyer-Stamer

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