

TECHNOLOGICAL CHALLENGES OF AN ALTERNATIVE STYLE OF DEVELOPMENT IN LATIN AMERICA

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Palavras-chave: América Latina, planejamento tecnológico, planejamento econômico, desenvolvimento autosustentado

RESUMO

O artigo visa contribuir para a discussão acerca dos rumos da política tecnológica e científica na América Latina a partir de uma perspectiva distinta daquela que vem se impondo como o 'senso comum' neste campo, apoiada no receituário neoliberal. Nosso propósito é discutir as alternativas de médio e longo prazo para o planejamento tecnológico e científico da região frente às demandas tecnológicas que apresentariam os vários setores produtivos, quando mobilizados no sentido de atender as metas sócio-econômicas de um estilo de desenvolvimento autosustentado. Em especial nos preocupam as possibilidades de aplicação do novo conhecimento científico e tecnológico, em processo de consolidação nos países centrais, no equacionamento da componente tecnológica dos problemas ligados às necessidades da maioria da população latino-americana.

ABSTRACT

The article aims to contribute to the discussion about the scientific and technological policy in Latin America. Its approach is quite distinct from the one being implemented in the region, based on neoliberal prescriptions. Our purpose is to discuss medium and long-range alternatives for technological and scientific planning in the region, considering the technological demands of the productive sectors when mobilized towards meeting the socio-economic goals of a alternative, self-sustained, style of development. We are particularly concerned with the possibility of applying new scientific and technological knowledge currently being consolidated in the central countries, to the technologies challenges posed by needs of the majority of the people of Latin America.

Latin American is now facing the impact of neoliberal prescriptions

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oriented to implement an economic structural adjustment that tends to aggravate the already unfair character of our development model. At the same time, political positions and coalitions sensitive to the situation of extreme need in which the majority of the population lives, and to the potential contained in regional cooperation, seem to be gaining strength. Given the transforming potential of this tendency, a better articulation is required of proposals currently formulated at a strictly theoretical level, in order to implement effectively a new style of development for the region.

The present work aims to contribute to that effort, focusing on some questions related to technology and science. The work explores, in a fairly provocative way, views and strategies which conflict not only with those being implemented in the region, but also with those constituting 'common sense' in this field.

Our purpose is to discuss medium and long-range alternatives for technological and scientific planning in the region, considering the technological demands of the productive sectors when mobilized towards meeting the socio-economic goals of a new, self-sustained, style of development. We are particularly concerned with the possibility of applying new scientific and technological knowledge² currently being consolidated in the central countries, to the technologies challenges posed by needs of the majority of the people of Latin America.

1. Structural Heterogeneity and Proposals for Change

The current socio-economical situation is characterized by huge inequality, expressed at the national level, by the (personal and functional) concentration of income, regional inequality, and contrasting levels of productivity among sectors.

Such inequality, considered by reformist thought of the 1950's and 60' to be a dualism typical of the Third World, has been aggravated in several aspects, especially in the social area, in spite of the intense industrial development observed. This situation requires a reexamination of that analysis and, in particular, of the strategies for change that it proposed.

A more conservative position considered dualism as an aspect of the initial stage of development. Consequently, to the extent that the style of industrial development typical of the central countries was adopted, there would be an 'absorption' of the underdeveloped sector into the 'modern-industrial pole leading, through the trickle-down effect, to an increasing social and economic homogeneity.

² Use of the term 'new' in this expression may be controversial since, as know, the scientific knowledge on which the the "new technologies" are based, was generated in the early decades of this century. It is used here however to emphasize the still incipient "materialization" of this knowledge in recent technologies or "technological packages". One consequence of such incipency is that this knowledge may be embodied in a wide range of applications.

A second school of thought, which formulated the concepts of underdevelopment and dependence, differs from the previous one on two central points. Development is not seen as a linear process, but rather as something far more complex, related to internal and external political determinants. Also dualism is understood not as the inconvenient heritage of a backward past ('pre-capitalist', according to some), to be necessarily overcome through growth. Rather dualism is considered a structural component of underdevelopment; intrinsic and functional to the process of 'unequal and combined development' characterizing the periphery of the capitalistic system.

Thus, while these two perspectives agreed as to the dualistic nature of society, they disagreed on both the causes and the pre-conditions for overcoming such a situation.

There was also an additional point of agreement. One which was not explicit at the time and which was made irrelevant by the political events that buried the structuralist view as an effective alternative. This second point of agreement involved the goals to be attained. Both positions visualized as ideal an economy based on industrial activity, increasingly efficient and 'technology-intensive', capable of providing everyone with a standard of material consumption similar to that of the central countries. Given the basic differences already cited between these conceptions, alternatives conceived to reach this ideal included strategies as diverse as 'increasing the pie and then sharing it', and armed struggle as a route toward a socialist society.

2. The Limits of the Conservative Position

After all these years of implementing the conservative strategy, with all the resulting iniquities and distortions, Latin America is again faced with the possibility (and the urgent necessity) of adopting a reformist path, one which may both lessen the existing inequality and allow us to build a viable and fairer society. This leads us to the need for outlining the style of development, which, as already suggested, is not only desirable but mandatory. In this sense, we will retain the parameter of material consumption, which has a especial importance for our analysis of technology policy.

The question to be posed immediately concerns the possibility of offering to the entire population of Latin America a level of consumption similar to that of the developed countries. Leaving a side, the ethic-philosophical questions involved in doing so (largely questioned in forums that increasingly escape the domain of the central capitalist countries), we will address a more decisive aspect, namely that of ecological viability.

Taking the current situation of both developed and Third World countries, and their growth hypotheses, as the point of departure, it is possible to predict the ecological consequences of maintaining the current style of development and the continuously

increasing material consumption that implies. Let us assume, as some international institutions claim, that the levels of material consumption of these two groups of countries were to be equal in a period of, for instance, forty years³. (This implies some unrealistic assumptions: that the group of underdeveloped countries will increase its income at an annual rate of 11.5%; that the rate of population growth will decrease to 1.5% per year; and that the developed countries will grow 3% per year, with an annual rate of population increase of 0.7%).

The resulting rate of consumption per capita, equal between the two groups would be approximately two and a half times the current rate in the developed countries, and forty times that of the underdeveloped countries. This situation would impose an huge increase in the pressure upon the environment. If we approximate the environmental pressure by the consumption of steel and energy⁴, we conclude that it would be fourteen times greater than today.

This simple exercise does not consider the possibility that the emergence of new technologies in materials, energy, or biotechnology, among others, and in ecological management, could contribute to minimize pressures on the environment. Nevertheless, such an enormous pressure increase is out of proportion: well-known ecologists assure that even the current amount of pressure on the ultimately finite resources of the planet is itself unsustainable. This exercise leads us to conclude that the attempt to reduce inequality through the current style of development is not only politically non-viable but also inherently self-destructive in character.

When considering the viability of the industrializing model in the region, another point worthy of examination is that of technological unemployment, resulting from introduction of automation in productive activities and services. The development process in the post-war era has been characterized by the diffusion of a technological paradigm that was already consolidated in the beginning of this century - and hence a paradigm far from being revolutionary in terms of its social-institutional impact. If such a diffusion was not capable of avoiding the increase of structural unemployment - on the contrary, it tended to reinforce it - then what can be said about the current wave of innovations? What will be the employment consequences of this cluster of innovations, which will tend to diffuse - indiscriminately, if allowed - to all sectors of activity? What possibility will the industrializing model have of incorporating the mass of the marginal population into jobs with an acceptable level of productivity, a minimal requirement for that population to satisfy its basic needs? It is difficult to be optimistic when countries far more prepared in social, institutional and economic

³ I am indebted to Amilcar Herrera to the formulation of this example.

⁴ The ratio between developed and underdeveloped countries for steel and energy per capita consumption is, today, approximately 18:1.

terms to face this impact tend to watch resignedly growth of unemployment as a natural catastrophe, impossible to handle creatively.

3. Toward an Alternative Strategy: some considerations

The intent this far has been to point out the impossibility of following the current 'industrializing' model, and the need to forge a new strategy of development, directed toward the establishment of a truly viable society in the long run. A central element of this new style of development is parsimony, meant to represent an alternative to uncontrolled consumption - the latter being both ecologically unsustainable and reducing the realization of human potential and aspirations to the strictly material level.

It is from this premise, the need to forge a new path, that the question of reducing existing socio-economic inequalities must be approached. A break with the framework used until now seems inevitable, since maintaining its promises, mechanisms, causal assumptions, and objectives, would lead us to new situation of impasse substantially similar to the one in which we have been living. One need only look at the situation of the developed countries to realize what kind of future - even with best of the hypotheses, which is forcefully unrealistic - we can hope for, if we persist along such a path.

It is difficult to establish in precise terms the meaning of this rupture with the actual framework or contents of a new strategy, particularly considering the objectives of this paper. We will therefore restrict ourselves to a specific question, that of the technological and scientific aspects of strategies for reducing existing socio-economic inequality. Obviously, this means assuming the existence of the political will to make such change viable. Such an assumption allows us to concentrate attention on conflicts of opinion at lower levels, which may emerge among decision makers in the area of science and technology.

In this regard it is important to emphasize a point discussed above in the debate on dualism, about the direction of causality in the process of aggravating inequality. Such a process occurred, not because the 'dynamic sector' was not able to produce the necessary stimulus for modernizing the 'backward sector' but rather because the aggravation of disparities was a functional condition for the operation of the proposed development model, and thus a logical result of the model's implementation. This means that the problem cannot be faced by inducing the development of the periphery through a modernization of the center (including a technological modernization). A plausible solution must attack the problems existing in the 'backward sector' through specific, localized measures, able to break up the above-mentioned causal link.

The same reasoning applies to the question of reducing inequality, often approached as a problem of distribution of the

surplus generated in the productive system. In other words, provided that surplus production takes place anywhere within the system, it will be always possible, given the right political conditions to transfer resources to social programs. Consequently, the problem would consist of increasing productivity - through the use of more efficient techniques - in the sectors where this seems to be viable, and to channel the differential of income to the deprived sectors. Such a strategy deals with the problem of 'social efficiency' (understood as a concept related to the equity in income distribution) as if it could be solved by the increase in economic efficiency made possible by technical efficiency. However, obtaining an increase in economic efficiency in a particular sector often causes 'social efficiency' to decrease, albeit in a localized way. This mechanism becomes more and more evident in areas of application of new technologies, particularly in automation, where the immediate consequence of the increase in efficiency is the generation of unemployment, hardly counter-balanced by the system as a whole.

This suggests that the issue of social efficiency cannot be disregarded by postponing it, as though it was to be reached merely as a result of increasing technical and economical efficiency. Just as the question of heterogeneity must be solved by simultaneously addressing the center and the periphery, so too must 'social efficiency' and technical and economic efficiency be handled simultaneously. In other words, it seems necessary to escape the 'trap' represented by the artificial and harmful separation between these two notions, and to look for new analytical tools. Incorporating the social dimension, alien the logic traditionally used, in to decision making thus - 'dismantling the trap' - is a theoretical and political challenge of great importance. Development will only mean well-being for all if the implementation of this new view, through the participation of all interested social segments, becomes possible.

4. The Alternative Style of Development and Technological Planning: the Need for a Methodology

With these considerations in mind, is possible to return to the question of a technological and scientific strategy suitable to an alternative style of development, and the methodology for such a strategy.

In Latin America, scientific and technological policies have been characterized by their demagogic and manipulative content. Anti-popular governments, incapable of proposing a 'National Project', have formulated S&T policies not supported by necessary economic, financial and productive measures. The objectives stated in S&T plans have not been fulfilled, because they contradict more general governmental orientations. The actions ultimately implemented have been led by priorities distinct from those of society as a whole.

Even in the few situations where there was a sincere

intention of implementing S&T policies directed towards consensually accepted objectives, such implementation occurred without an adequate methodology. The actions in the S&T area did not follow broader development objectives. For example, achieving a broader goal was often associated in a hasty and superficial way to efforts to train human resources, when in fact the real effect was to dispense with such efforts. Often, all that was required was a more rational mobilization of the existent potential, or the immediate absorption of technology (or even less). This bias, typical of the academic community, is not the most harmful: the training of human resources contributes, at least, to the advance of knowledge, which is always useful and necessary. It would be worse if, facing an economic/social development goal, the decision was made to invite a transnational corporation (TNC) to establish itself in the country and apply its own technology. This is an important observation, in that it shows the need for planning procedures to formulate T&S⁵ strategies in those cases where a change in the socio-political context is assumed possible. There is an evident lack of methodology suited to link the demand for desirable futures to existing technological and scientific capacities, and to the opportunities to apply new knowledge.

The methodology that seems necessary is one minimizing the occurrence of situations such as the one mentioned above. It must be able to confer a greater objectivity and transparency to the formulation of scientific and technological policy, making explicit the casual chain that should link the broader aims of socio-economic development to productive, technological, and scientific strategies (in this order). In the following paragraphs, we introduce some elements and criteria to be considered in the formulation of such a necessary methodology.

The methodology must assume that the political conditions for implementing an alternative style of development exist from the start. The methodology is concerned solely with creating material conditions at the productive, technological and scientific level. In other words (and to use the economists jargon), the focus is on the 'supply side' and not the 'demand side', which is assumed to be assured. Therefore, it is important to emphasize that we are not concerned with political decisions, nor with the industrial and agricultural policies deriving from them. Our concern is limited to the technological components which derive from those policies.

We must avoid the mirage that confounds those who establish a casual link between our technological gap vis-à-vis the central countries and our much more deficient social situation. We must recognize, from the beginning, that the solution to the great

⁵ By using the expression T&S - instead of S&T - we intend to call attention to the fact that technological policy is prior with respect to science policy, in the sense that it must be guided strictly by broader development goals. Science policy can and perhaps must have a larger degree of freedom, following the criteria held by the scientific community.

majority of Latin America's socio-economic problems requires political will more than technological development. It is reasonable to expect, based on recent historical experiences, that progressive social and political changes will generate conditions for achievement of these technological components.

Reinforcing involves a great variety of complementary and/or alternative actions, ranging from the training of human resources for higher level research, to the stimulation of 'joint ventures' between national and foreign capital, seeking technological absorption. Without a detailed description and a strict definition of priorities with respect to various needs, however, it will be impossible to determine the type of action to be taken and the areas in which to act.

Autonomy does not mean 'autarchy': we can and must continue to import technology, inasmuch as the conception of technological solutions, and the process of their implementation, are nationally controlled. The most successful Latin American experiences in strengthening technological autonomy show that the crucial capability is that of 'mixing' imported technology of distinct origins and vintages, with technology developed locally through a continuous process of human-resources training and research. Such capability allows identification of those technologies, components, and other inputs that must be controlled or produced locally, and those that can simply be imported.

The Methodology

Characterizing the profile of the present situation is a condition for applying the methodology. Using the same variables, outlining the future profile will make it possible to identify socio-economic deficits whose elimination will eventually require an increase in social productive and material capacity. The gaps between the future and current productive structure constitutes what we refer to as productive demand, established in each important sector according to the goals for society as a whole.

In establishing productive demands, a first 'filter' has already been introduced. Actions referring to those goals that do not imply an increase in productive capacity and which, therefore, will not require measures in the technological and scientific area, are excluded.

The next step is to investigate whether the identified productive demands determine any kind of technological demand⁶. It is perfectly possible that a productive demand even when significant,

⁶ It is important to emphasize that the proposed methodology should be applied in a recurring or iterative way, so as to introduce information and/or hypotheses which are indicated as necessary by the gradual application of the methodology's steps.

can be fulfilled without technologically derived inputs or, with an even higher probability, without inputs from new scientific knowledge. Evaluating this question requires a detailed knowledge of the situation in each of the productive sectors, including the sector's technological profile, as well as the international trends of technological change that affect that profile. The technological demand must always be considered in terms of the trade-off between expanding production and productive capacity at the existing level of productivity, and assuming the possibility of a higher, yet-to-be-achieved level of productivity. It is thus necessary to examine the magnitude of productive demand, to evaluate whether it can be satisfied only through an extensive increase in production or whether some kind of productivity increase is required.

In the case of identifying a need for a much more efficient technology, to meet productive demand, one radically distinct from those currently in use or available, the next question would be one of viability - that is, to investigate the possibility of developing such a technology. This evaluation assumes that specialists in the field know the state of the art of international knowledge and, further, that they are capable of moving along unexplored and heterodox paths, in the search for adequate solutions. The criteria which would direct this search would be fundamentally technical, although those concerning the various goals of the style of development should also be present.

A general approach to the problem of choosing among alternatives would be compare, for each, the cost increasing (through the several available ways) technological and economical efficiency with the income generated. In this respect, it is possible to say that in Latin America countries, it is usually less costly to buy, adapt, or steal technology than develop it from the beginning of the R&D chain. It is obvious that the second option may have extremely important side-effects in terms of the learning process and the establishment of indigenous S&T capacity. Moreover, indigenous development may be the only option some cases. This is true for so-called new technologies, which are often unavailable for purchase. It is also true for conventional technologies, which, in order to fit Latin America reality, sometimes require a reconstitution of the original process, beginning with the first productive application of the respective scientific knowledge.

The producers suggested above would require an ordering of the alternatives, according to their cost and efficiency, in each sector, in such a way as to determine the corresponding global optimization point. It is important to remember that optimization cannot take place strictly within each sector, since the different sectors compete among themselves for scarce factors (resources personnel, etc).

An important element to be considered is the sector's relative weight within the economy. It is necessary to prevent the extreme case, in which a costly increase in technical efficiency yields a small increase in the economic productivity of a sector with

negligible relative weight (either in economic terms or in terms of its importance with respect to the overall goals). It is intuitive, and sufficiently accurate for a preliminary analysis, to assume that, in order to achieve a given proportional increase in the technological efficiency of any sector, the amount of resources to be applied in R&D is constant. Thus, independent of socio-economic priorities, distinct sectors would show a distinct attractiveness for R&D efforts. The economic impact of allocating a given amount of resources to technological development, and therefore the multiplying effect in terms of increase in GNP, would be proportional to the relative economic weight of the sector. In other words, the most important sectors (in terms of their contribution to national product) would work as carriers of economic development.

5. Applying the Methodology to the Productive Sectors: 'technological pluralism' as a condition for overcoming heterogeneity

The criteria mentioned above, which should integrate a methodology necessary to formulate a technological and scientific strategy compatible with an alternative style of development in the region, can be applied (though provisionally and as an example) to Latin America reality. Taking as a point of departure, the current productive structure (its distinct sectors characterized by the type of goods produced, demand supplied and technology used) and the priorities of the new style of development proposed, it is possible to outline the resulting technological demands and the strategies to be followed for satisfaction of that demand.

The criterion of 'sectoral partition' proposed for this exercise is limited exclusively to the objectives of the exercise. The fundamental purpose of the exercise is to make evident that, given the existing heterogeneity, it is essential to adopt a 'technological pluralism'. Such a posture is needed to approach not only the question of the different levels of modernization and technological reliability (or tolerance) required, but also the diversity of possible actions in the distinct fields of State intervention. Such fields range from scientific research to reverse engineering and technological transference. One of the central motivations of the adopted criterion is the idea that our problem in the technological and scientific area is not to fill the gap between our countries and the great technological powers, such as the U.S. or Japan. A strategy of simply 'complementing' the backward fields would be valid for countries such as France, with socio-economic and S&T structures both similar to those of the hegemonic powers.

We recognize beforehand the precarious and scarcely established character of the proposed 'sectoral partition'. We maintain, however, its adequacy for the pursued objective, recognizing that it conflicts with conventional classification. Among the problems presented by this 'sectoral partition' is the fact that

it segments sectors, branches of activity, and even enterprises⁷, and then aggregates some of these elements. The aggregation criterion is the type of final good produced. A sector is constituted by the vertical complex of activities and stages of production enabling the attainment of a given goal, established at the level of overall socio-economical planning. Consequently, it is inevitable for the boundaries of each one of the sectors to be relatively diffuse. Some of the productive activities included in one sector are 'also part of another'. This fact, nevertheless, does not compromise the considerations to follow.

5.1 The Modern Exporting Sector

First there is the modern exporting sector, which could be defined by exclusion as the sector that does not produce traditional exporting goods for markets in which the country has static comparative advantages. The fundamental responsibility of this sector in the style of development proposed is to guarantee a flow of foreign currency compatible with the growth rate desired for the economy as a whole. This sector has been pointed out as an important element in diffusing innovations and producers of greater efficiency for the rest of the economy. As will be made clear throughout this work, our position is quite different; for this reason, this subject will not be explored here.

Rather than being consciously planned, in the long run, to occupy foreign markets, as in the case of the South Asian countries, this sector emerges from the export effort of recent years, burdened by the external debt, and based on a naive interpretation of the experience of those countries. This export effort, supported by a set of governmental subsidies, led to a transformation of industrial segments, traditionally oriented to the internal market, towards the international market. In terms of the activities included and the products generated, this sector does not differ clearly from the next to be described. The export sector is described separately to point out the role it has been performing and to indicate a tendency towards favoring it, which seems to us fundamentally mistaken. In addition, singling it out will help analyze its technological demands apart from those of the productive structure as a whole. In fact, this procedure, though strictly analytical, makes it possible to evaluate the correctness of government policies designed to separate this sector from national industry as a whole.

This sector might be seen as a result of the attempt to 'Koreanize' some modern sectors of our industry, engaging them in the endless effort to pay the external debt and providing an escape from the stagnation of the internal demand of their products, occurring

⁷ An analogous procedure is used to generate the concept of "arms industry" since almost all of its firms produce goods for civilian uses, or the concept of "industrial complex" increasingly used in studies of industrial organization.

since the beginning of the 1980's. Such an undertaking showed clear success in the good performance of some Latin American countries, obtained in part through exports from this sector. This fact makes the strategy mentioned above to be considered with optimism.

In this sector, technical efficiency is not negotiable, because of the need to reach a competitive level, similar to that of the more technologically developed countries, in markets where they hold almost absolute control. The characteristics and specification of products frequently oriented towards high - income consumption groups, makes practically mandatory the use of technologies very similar to those employed by TNCs. Thus, there is almost no room to develop technological alternatives, for the simple reason that it would be very difficult to reach the levels of efficiency obtained by the latest technologies used by those companies to produce goods adequate for the markets they control. Even if this was possible, the necessary effort would have an extremely high opportunity cost, due to existence of other sectors where the allocation of our scarce R&D potential, both human and material, is more convenient (this is a crucial point, to be discussed in more detail below).

An assessment of the relative importance of this sector in terms of the productive potential of the region cannot ignore the fact that, in spite of the exporting effort made in recent years, our 'opening coefficient' is still small relative to countries and regions that have emphasized the external market as a driving force for their development. Evidently, this fact must be considered when deciding how direct our productive potential and investment, particularly when facing the possibility of the region assuming a more autonomous posture with respect to the question of external debt. Such a posture, fully coherent with the style of development proposed, would release part of the resources now engaged in servicing the debt, with an evidently positive impact upon development. Such a release would contribute to diminishing the virtual importance of this sector.

Given that the technologies used in this sector would be fundamentally the same as those used in the more technologically advanced countries, the industrial goods to be produced for export with some kind of comparative advantage should have their technology, as a rule, absorbed from external sources and not developed locally. For this to occur, new mechanisms able to regulate the process of technology transfer must be created. It is worth emphasizing in particular the need for the exported products to be produced when possible by national companies, to avoid the leak of resources that occurs with the installation of TNCs in the region. In this sense, it seems that the general rule should be to select the technology to be imported within the market that will permit a number of options, rather than allowing the installation of TNCs which supposedly bring their technological knowledge as investment.

In terms of the local capability, we believe that, more than the capacity to develop technology or promote scientific research that could lead to the generation of technology for the

chosen segments, what will be necessary is the ability to import or copy existing technologies. Such a capacity will make it possible to take a shortcut towards greater efficiency, a procedure already adopted successfully by other countries. This will also avoid the risk of getting lost in purist or chauvinist initiatives of 're-inventing the wheel', which are not only non-viable, given the effort and time of maturation required, but also lead to engaging our scarce S&T potential in needs that are far from those of the majority of the population. In addition, even if technological competition with the developed countries in this sector becomes possible, a highly unlikely hypothesis, the possibility of reaching markets which justify the investment in R&D is remote. To admit our condition of subordination in this field seems to us to be a healthy attitude.

The capacity needed should include an exhaustive technical and economic monitoring of existing trends in innovation. This will allow the administration of our technological gap, and make it possible to establish the relative importance of the various existing areas of innovation. This will also make it possible to take advantage of the little-explored differences among the various countries and TNCs able to satisfy our demands in this field with useful technologies. This capacity will be necessary both in the productive segments controlled by the TNCs, where a more strict 'code of conduct' should be effective and supervised by Latin American technicians, and in those segments controlled by national capital.

5.2 The Sector of Industrial Goods for Internal Consumption

This sector includes final - assembly industries and the entire infrastructure for their operation. Consolidated through a continuous process - although not linear or systematic - of import substitution, the sector presents today - at least in the bigger Latin American countries - a reasonable degree of industrial linkage and productive completion. The market it supplies, although relatively small due to the existing process of exclusion and marginality, has allowed a high degree of economic dynamism, expressed in its historical high rates of growth. The reversal of exclusion and marginality, through social reforms, would tend to extend the market significantly and attract larger investments for the sector, reinforcing the participation of national enterprises to be selectively stimulated. Unlike many analysts, we believe that this alternative, emulating a 'new phase' in our import substitution process and bringing into the market the enormous proportion of our population now marginalized, can pave a safer way than the 'Koreanization' mentioned above.

The structure of property in this sector is marked negatively by the presence of TNCs, which tends to reinforce an imitative behavior, dependent on the technology imposed pervasively by the current development style. The technology utilized is, fundamentally, that diffused in recent decades by the TNCs, submitted to a process of adaptation in the region by different types of enterprises, usually with minimal support from the local R&D

structure.

TNCs controlling this sector tend to follow a technological behavior characterized by the diffusion of innovations introduced by the head offices in their respective countries. However, there may be interest in adapting the 'new technologies' - much more flexible in terms of production scale and product characteristics - to the expanding market, which is receptive to less sophisticated products. Such interest shall be explored by the governments of the countries of the region trying to direct TNCs, as well as national enterprises, toward the development of technologies more coherent with socio-economic priorities, such as employment expansion or supplying cheap and efficient products.

The 'technological tolerance' and the opportunities for pluralism are greater in this sector than in the sector discussed above. Here it is possible to sacrifice efficiency since the sector must compete with goods produced by other countries within our own territory, and not with the international market. The degree of freedom for alternative technological solutions is greater, due to the broader flexibility in product specification. It is also easier in this sector to add other criteria such as employment generation, reduction of regional disparities, environment protection, etc., to the technical and economic rationale. 'Defensive' actions may also be implemented in this sector avoiding the use of the latest fashion on the technological shelf and thus escaping predatory effects with respect to employment, environment, etc. Protectionism, so pervasive in Latin America and justifiably qualified as 'frivolous', must be used conscientiously for this purpose.

It is in this sector that the deepening of the 'technological learning' experience, already sufficiently documented by Latin-America authors, might have good results, if consciously stimulated. The mobilization of the potential of our R&D structure, up to now scarcely linked to productive activity, would allow the multiplication of well-known achievements in adaptation.

Although the role of this sector should continue to be supply of internal market, it is reasonable to expect that measures such as those proposed would give birth to a process - natural in the developed countries - of gradually directing to the external market part of the production of sectors where technological and industrial ability is achieved. This process would require a strategy of articulation and completion of our industrial structure.

An increase in regional integration and strengthening trade with other Third World countries may be a way to escape the uncomfortably heavy dependence on U.S. imports, which includes subjection to instabilities in the U.S. economy. In this case, the use of technologies not at the frontier of innovation in the developed countries will not normally be a serious problem. On the contrary, both for internal use and for the Third World market, an intelligent combination is needed of modern technologies and those already widespread and controlled (a capability which the central

countries have not demonstrated to a high degree). In addition to many other lessons it offers, the Brazilian arms industry - whether or not we like the fact of its very existence - presents, through the implantation of its scientific and technological policies, a model of creativity, autonomy and adaptability that is worth considering.

Considerations of this type show that the potential of this second sector, in terms of external trade, can be much greater in the medium and long run than usually thought.

5.3 The Sector of Goods for the Basic Needs

In Latin America, the basic needs of the population are undoubtedly neglected. This is particularly true if basic needs are understood as a changing, dynamic concept, since they constitute those needs whose satisfaction makes possible the individual's integration into his own culture, time, and place.

The first characteristic of this sector, deriving from the very concept of basic needs is also its mutable nature. Although this sector like the others, constitutes a sort of heuristic abstraction, it could be merged to a large extent, with the so-called subsistence sector. Its social and economic importance can be determined given the deprivation of the majority of the population in areas such as food, housing, education, etc, and the potential demand in segments producing goods and services directed toward fulfilling these needs at a basic level. To the extent that this level is reached, this sector will gradually merge with the sector of industrial goods for internal consumption, considering the need to provide the entire population access to other types of goods and services that will become part of those items the attainment of which make cultural integration possible.

The second characteristic of this sector is its technological heterogeneity. Considering that basic needs have been fulfilled throughout history in very different ways, it is also easy to assume the coexistence of different technologies. In fact, human history can be simplistically identified as a cultural transformation leading to the establishment of new necessities once the more basic ones had been assured. In Latin American countries, a well-known process occurred of emergence of 'new needs' in the higher-income sectors, before the basic needs of the entire population had been fulfilled. The development of the economies of the region was based on the productive effort related to these 'new needs'. In these economies, technological modernization also occurred in the modern sector without the already discussed 'trickle-down effect'. Meanwhile, the sector linked to basic needs, less dynamic and profitable although atrophied and not sufficiently explored remained marginalized with respect to such a process. Unlike to what happened several decades ago in the developed countries, where technical progress was first introduced in the basic - needs sector as a result of the presence of an effective demand, in Latin American countries there is a technological 'marginalization' of this sector.

This process has led to a situation today in Latin

America in which those branches most important for achieving the social goals of an alternative style of development are precisely those most backward in technological terms. In fact, the technological gap in relation to the central countries of branches like the food and textile industries is far greater than the gap of branches such as those producing goods for durable consumption.

The usual identification between the fulfillment of the basic needs of the population of the Third World and the sector's inefficient and backward technologies is an artificial and hopefully transitory situation, resulting from the process described above, and not an inexorable given. On the contrary, there is much room - and surely great need - for optimizing the technologies used in this sector, through the incorporation of 'new scientific and technological knowledge'. The goal of fulfilling housing needs seems to be one of those demanding an increase in 'production' that cannot be achieved within the limits of current technological, and perhaps scientific, knowledge. New building techniques will be needed to fill the existent housing deficit, within a socially acceptable term³. Radical technological solutions, probably very intensive in new scientific research, will be required, as well as use of traditional techniques, eventually 'renewed' through new knowledge.

Being particularly sensitive to physical, socio-economic and other characteristics of the environment the fulfillment of basic needs requires specific forms of productive organization and technological solutions. That is to say, either these solutions will be developed by us, or they will not be developed at all. It is possible, nevertheless that, should this market grow significantly, it will tend to attract the attention of TNCs for the generation of technologies which consider more fully our own reality. Even in this case, however, there will be an obvious subordination of such adaptation to the typical criteria of these enterprises, frequently predatory to the country at the social and economic level. As an example, the possibility can be mentioned of TNCs creating a new 'agricultural package' based on biotechnology to replace the 'green revolution' package, widespread in the 1960's and 70's with highly unsatisfactory effects.

The packaging of 'new scientific and technological knowledge' by the central countries according to their own needs is currently a natural process. However, the same potential of increasing efficiency presented by a such a 'packing' - in the areas and with the purposes to which it has been applied - can be used to satisfy the demands of our own reality. Mechanisms to materialize this possibility must be implemented urgently before the expected

³ In order to give an idea of the problem, it is sufficient to mention that the Itaipu hydroelectric dam, considered the biggest in the world, with an estimated cost of approximately 16 billion dollars, needed an amount of cement approximately equal to only 7 million "popular standard" houses, a number totally unsatisfactory to solve the Brazilian housing problem.

market expansion itself increases the interest of the TNCs in selling us their new technological packages.

In the underdeveloped countries, the fulfillment of the basic needs is - or should be - responsible for a substantial part of the productive effort and employment. Therefore, any related change in technology, either in productive efficiency or in terms of its impact on the social fabric or the environment, has a huge multiplying effect. With regard to the urgent need to increase the level of employment, it is worth mentioning a thankful coincidence: the industrial branches most capable of absorbing labor force are precisely those most directly responsible for achieving the objective of fulfilling the basic needs of the population⁹.

It is important to point out that in the case of the two sectors analyzed previously, the likely frontier of technological expansion is already known, or can be known from observation of current trends in the central countries. In fact, the evolution of the process of incorporating 'new scientific and technological knowledge' to the production of those kinds of goods is easily foreseeable. In the case of the basic % (* sector, however, there are no visible technological alternatives. As mentioned above, the TNCs are concerned about the introduction of innovations in the most dynamic and profitable segments of industry in the central countries. These segments are oriented towards a large proportion of the population in those countries, which is far from being the Latin American reality. Innovations in product technology intensely utilizing opportunities opened by informatics, with its application biased toward high income consumption, are an example of this.

In the sector linked to basic needs, even if we wanted to import technology, it would be difficult to find an appropriate one. Therefore, this sector must receive priority in the allocation of our potential of basic and applied research and of training human resources. This must be done in such a way that, entering early in the R,D&E chain, and 'surfing the current innovation wave', it becomes possible to generate efficient technologies suitable to our problems. Linking scientific and technological policies to economic and social ones is important, in order to undertake a strategy of reducing inequalities by acting in areas of less political resistance, where the State can play a more incisive role. State action must be explored as a viable way to develop technologies in areas where the State is directly responsible for fulfilling the population needs. The aim must be to increase productivity precisely where its immediate positive impact can be greatest, and where it is important to assure a process of social transformation such as the one proposed here.

⁹ For the Brazilian case, the coefficients of employment-product elasticity for some industrial branches are as follows: metallurgy, 0.54; mechanics, 0.57; clothing and footwear, 0.56; food, 0.84; building, 0.96.

Unlike the emphasis given by other analysts to technological research, we consider the acquirement of a basic capability, in areas directly linked to this sector, as a necessary condition for keeping up with and using creatively scientific and technological knowledge in a process of change, and for redirecting its application when necessary. In addition to the capability in basic science, the monitoring of international trends of 'new scientific and technological knowledge' is also necessary to allow, in the course of the proposed process, technological applications more closely related to the demands of other sectors.

In this sense, it is worth recalling the mutable character of this sector, which confers on it an important role in the future orientation of the sector of industrial goods for internal consumption. To the extent that more basic needs were being fulfilled, this later sector would be transformed into a nucleus for promoting economic development and generating an endogenous technological dynamic. Thus, it is a question of directing that sector toward the fulfillment of internal demand in the segments of goods consistent with the expected increase in economic and social development. At the same time, this will make that sector able to operate as a battering ram in order to expand our external market. This solution seems to be a much better alternative than transforming the sector into one subordinated to the transitory need of maximizing our exports.

5.4 The Sector of Goods with Dynamic Comparative Advantages

The fourth sector identified is that producing intermediate goods and raw materials, which, considering the specificity of our natural resources and of the external market, can profit from either existing or created comparative advantages. Such products may come to play an important role in external trade, to the extent that technologies for efficient production, normally unavailable in the international market, were developed. Similarly to what occurs in the basic-needs sector, these technologies - mainly production technologies - will have to be developed internally principally through the mobilization of national capacity in basic and applied research. The development of original technology can play an important role in this sector, in protecting the activity of national capital. It has been in segments still incipiently installed that the penetration of the TNCs has been shown to be avoidable. In these cases the novelty of the technology, previously developed through a concentrated effort of the State, served as a 'technological shield' to the action of the TNCs.

Again, as in the previous sector, the establishment of a capability in scientific research and technological development will be more important than the ability to use and to adapt foreign technology. This ability, on the contrary, will be crucial in the case of the first sector presented, the Modern Exporting Sector.

Experiences like those achieved in Brazil, in the areas

of alcohol production, deep-water petroleum extraction and, niobium and titanium production, show the viability of this alternative. Areas such as the exploration of sea resources, or biomass and genetic resources, seem particularly attractive for the countries of the region.

The substitution of products of wide consumption for internal use, often imported or produced from foreign raw material, is a source to be explored. Supported by our R&D capacity and by the monitoring of international trends, we may enter the external market 'before the demand', with competitive inputs which fulfill the needs of dynamic segments in the central economies. This anticipatory behavior is fundamental in order to take advantage of the current trend in the new international division of labor of substituting, saving and of diversifying materials, and also from the perspective of biotechnology. The negative potential of such a trend for Latin America, in terms of loss of comparative advantages and industrial relocation, is already sufficiently known as to deserve a specific policy such as the one indicated. It is convenient to emphasize that we considered naive and noxious wanting to counter such a global trend.

6. Final Considerations

A final consideration must be emphasized: the pluralism proposed here does not refer to level of sophistication or modernity of the scientific and technological knowledge to be applied in the different sectors of the economy. Rather, it concerns the autonomy with which this knowledge is arranged in order to satisfy our productive demands. In this way, it will be possible - and this is what we believe must be tried - to use frontier knowledge in order to increase productivity in activities related to basic needs. We also believe that, given the potentialities of 'new scientific and technological knowledge', it will be possible to increase productivity considerably by lowering the capital/product ratio. This will avoid, at least in the short term, when it is more troublesome, the traditional bias of technological progress, which tend to save labor; precisely the abundant 'production factor' available for us to use to recover from marginality.

Technological pluralism must also lead to a more flexible and intelligent interpretation of technological demands. This will make possible the use of our R&D potential, applying it to areas where there is a real priority and where the effort spent can generate better results.

At the beginning of this text, we pointed out its controversial character. In fact, one of its central ideas, which states that the major effort of mobilization of our R&D potential must not be allocated to the sector that seems most promising and most deficient in innovations (which has been concentrating the attention of the central countries), constitutes a negation of mainstream thinking in the area.

Another controversial central idea refers to the possibility of generating conditions conducive to a technological and scientific dynamic determined endogenously based on our own needs rather than a vain attempt to reproduce the dynamism of the central countries through the adoption of an imitative standard of R&D.

Intended as an input to the debate, three characteristics of this text might possibly be forgiven: the complete absence of citations of authors and documents, the disregarding of important aspects which do not directly reinforce the argument developed, and the overestimation of those which make it possible.

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