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Policy-making

Science and technology policy and S&T indicators: trends in Latin America

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Starting from evidence that Latin American science and technology policy (STP) is undergoing a transformation, current conditions are analyzed to establish a counterpoint between the STP/indicator interface in advanced countries and in Latin America. Based on introducing in the decision-making agenda a scenario of economic democratization and the satisfaction of social demands, some of the implications of such a transformation in STP for S&T indicators are suggested. The analysis shows that the available indicators are not relevant in shaping STP in advanced countries. It then demonstrates how the institutional supply-oriented model, the structural factors of S&T development and the poor relationship between the social actors responsible for its direction, have given rise to a situation of even greater inadequacy in Latin America. To satisfy the new scenario some suggestions are made for the work required with regard to indicators.

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CURRENTLY THERE ARE two noteworthy aspects of science and technology policy (STP) and S&T indicators in Latin America. The first is the emerging consensus among researchers of STP as to the importance to the field of S&T indicators. Homogeneous and reliable indicators of innovative activities and potential in each country are viewed as a prerequisite for scientific and technological cooperation, which is increasingly considered as a focal point for the future of Latin America.

The second is the strengthening of a position, currently held by a minority, but fully accepted until the late 70s, of the importance of incorporating social issues linked to S&T programs. The present moment is one of transition: it is necessary to choose between two paths. The first follows the current neoliberal trend, which reinforces the excluding nature of the present socio-economic model, based on a pursuit of competitiveness at any price. The second is aligned with political democratization in progress over the last decade, and the economic democratization scenario it brings with it. To satisfy social demands compatible with a more equitable society, quite a different technological mix compared to the first scenario is necessary. These two paths and their corresponding scenarios require quite separate and distinct S&T activities. Each would give priority to a different set of S&T indicators, to turn them into policy.

Current changes in the course of Latin American STP are aligned with the first scenario. They include a relatively recent concern for international competitiveness, derived from economic adjustment processes and from the fact that the model of substitutive industrialization (import substitution) has been

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abandoned. Both the idealistic perception of S&T as the driving force of growth, and the critical view of Latin American thought on science, technology and society, which were responsible for the broad outline of Latin American STP, up to the end of the 80s, have been set aside to make room for a new concept. Its core is that S&T activities have to be oriented to foster innovative systems which should serve the competitive standing of individual countries in world markets.

The second scenario of economic democratization, placing the satisfaction of social demands foremost, seems to arise in opposition to the first. The fulfillment of social demands is not used here as the last link in a linear chain of innovation but as the starting point from which to devise STP. Driven by criticism of the neoliberal orientation current in Latin American public policy, this alternative view should transform not only the content and objectives of STP but also the decision-making processes which give rise to it.

S&T indicators produced and used at present in Latin America serve neither the present trend of competitiveness with social exclusion nor the alternative of economic democratization. The STP needed by Latin America, whatever the future scenario may be, will require the construction of new types of S&T and innovation indicators. Since it is widely accepted that indicators used in Latin America do not differ from those applied in advanced countries, it seems convenient as a first step to consider how they were devised there. We then deal with the STP/indicators interface, showing how the institutional supply-oriented model, the structural conditioning factors of S&T development and the poor relationship between the social actors responsible for its direction, give rise to a situation of even greater inadequacy in Latin America than in advanced countries. Lastly, lines of work necessary in the area of indicators to put into operation a new concept of STP based on a scenario of economic democratization, are suggested.

Current indicators inadequate for STP

What is currently known as STP had emerged by the end of the Second World War as a consequence of the growing importance of scientific and technological knowledge, the emergence of 'big science', and the increasing role of the state in the management of research activities in advanced societies. Based on optimistic rationalizations, the scientific and military establishments in the USA capitalized on this situation and started the idea that S&T was a sufficient — not just necessary — condition for social development. Born within the environment of American policy-making were the concepts of the linear chain of innovation and science as an 'endless frontier'. This became part of the new social contract between the scientific community and the state. The institutional models thus created became core elements in the merging of a policy 'of science' and 'for science' in advanced capitalist countries.

The success of this model in the reconstruction of the economic, scientific and technical infrastructure of Europe and Japan reinforced its supposed universal validity. Differences resulting from the previous history of each country, and from the role they played in the emerging economic and technological post-war order gave rise to variations of the model, from a technological *laissez faire* based on the 'military Keynesianism' of the USA, to variants involving a significant degree of centralization, such as the French, the Japanese or the Swedish models.

It was precisely the fast growth of S&T systems in Europe and Japan (to a stage where they were comparable with the American system) that induced the development and collection of S&T indicators on a world-wide scale. A comparison of the evolution of rapidly growing national systems of innovation was needed, and this led to indicator production. The same supranational institutions (such as the OECD, Organization for Economic Cooperation and Development) that had advocated the generalized adoption of the linear chain of innovation institutional model also encouraged indicator production.

These inter-country comparisons were well-grounded, both from a strictly scientific and technological viewpoint and from the socio-economic context underlying S&T activities. The need to emulate the leading countries pressed policy-makers to close the gap in specific fields (gaps manifested in S&T indicators) and constituted a crucial challenge for STP. That the linear chain model did not suggest specialization and, on the contrary, viewed the development of expertise in every field as desirable and possible, created further pressure towards international comparisons of S&T indicators.

From the 60s onwards, indicators of scientific production began to show that the gap between the USA, on the one hand, and Japan and Europe on the other, was closing. The indicators of economic performance also pointed in the same direction. This simultaneity and positive correlation suggested a causal relationship between scientific–technological development and economic performance which reinforced the 'explanatory power' of the linear model.

However, for analysts who had influence on decision-making in economic policy, finance and so on, economic performance was understood as a result of variables in which the role of scientific development was practically negligible. Only later, with the neo-Schumpeterian approach, and the inclusion of S&T variables under the label of innovation, did a new approach to policy-making in the economic field arise, in which the creation of innovative capacity became a fundamental element.

Because that causal relationship was difficult to prove, economic indicators related to productivity, trade advantage in advanced technology products, and growth rates in the output of such goods, had no

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way of being linked to science indicators. Thus, despite great efforts and the profuse literature on science indicators, their impact insofar as proving that hypothesis of causality was restricted. Fortunately the supply-based institutional model was kept, and with it concern for the production of indicators, even though it was not possible to confirm the importance for economic development of that which they were intended to measure.

Importance in military R&D

During the period when European countries were concerned with decreasing the gap separating them from the USA, the USA and the former Soviet Union were involved in another competition, the Cold War. Scientific knowledge played a fundamental role in this political confrontation, as the arms race had a decisive influence on the development of S&T all over the world for over 40 years.

To remain 'cold', the Cold War required indicators to peacefully characterize the relative military advantages of the competitors. This advantage was directly measured in terms of the capacity to destroy (for instance, megatons of explosive). The military superiority of each bloc became increasingly expressed by the respective advantage in terms of military technology, inasmuch as this was the determinant of the destructive power of the armaments. When the power of destruction became greater than was necessary to annihilate the enemy several times over (the overkill phase), the arms race was transformed into a scientific–technological race which encompassed the S&T systems of both blocs [Editor's note: the 'Star Wars' phase].

The destructive capacity of armaments constituted an absolute indicator, uncontaminated by any economic or social cost–benefit considerations. In fact, the economic cost of the political advantage embodied in the most sophisticated scientific and technological knowledge was completely irrelevant for the industrial–military complex. The manufacturing of armaments always occurs on the fringes of economic rationality, in a territory where costs are not only irrelevant, but also not to be disclosed (or are kept secret). This contributed to the absolute character of S&T indicators concerning the arms race.

Contrary to economic performance, the relationship between military superiority and science did not need a causal hypothesis. Military superiority could indeed be directly explained by scientific advantage. Since science could be assessed by the traditional indicators, and these referred to knowledge for both military use and civil production, the importance of these indicators was enhanced insofar as they explained the type of power (military) that presided over the logic of the post-war world.

This seems to be a central explanatory element of why the indicators went on being important, despite their scant capacity for helping to explain the relation between S&T development and economic development and, consequently to serve as 'proxies' of countries' political power in the civil economic world.

The end of the Cold War triggered what economic globalization had already started, closing a chapter of history in which economic power was in some way dependent on political–military power. When it ceased to exist, the military 'pillar', which in an implicit way artificially upheld the importance of S&T indicators as a means of explaining the power of countries, revealed its dysfunction in S&T decision-making.

This situation is precisely what specialists are discussing at present in advanced countries. Traditional S&T indicators conceived according to the idealized supply-based view of the linear model, are currently considered by specialists in advanced countries to be inadequate for STP. This inadequacy arises from two aspects. In the first place, the causal relationship between science and the economy still belongs to the realm of hypothesis. Secondly, the relatively recent application to economics of the evolutionary theory of innovation, does not confer an important role on scientific activity, as such, in economic competition between nations.

'Relationship web' in advanced countries

The scientific community plays an important role both in developing STP and carrying out the resulting activities. The planning style adopted for STP has been incremental, despite its rational appearance (decision-making in a logical, encompassing manner, including the specification of objectives consistent with future stages to be attained on the path towards the 'best' policy). In other words, STP decision-making incorporates procedures typical of mutual adjustment among only slightly differentiated actors. Decisions accommodate the political environment and the wishes of peer groups, looking for a policy expressing the 'art of the possible'.

STP design, despite its top-down appearance (decision-makers at the top of a centralized pyramid feeding a hierarchical implementation process in which officials at the base implement the established objectives), is characterized by a mixture of styles

which include 'bottom up' mechanisms. In practice, there is a design–implementation continuum where many *ad hoc* decisions are effectively taken at the hands-on level, on a day-to-day basis, by professionals working in the S&T area.

Organizational theory and policy analyses suggest that bureaucratic structures are not likely to change. Changes in such structures are rarely autonomous; they are usually introduced from the outside by signals (and in the extreme, pressures) generated by interests and actors situated in the outer environment. These signals stimulate decision-makers to accept and catalyze organizational change. However, research institutions (including universities) are not typical bureaucratic structures. Even so, organizational change in research institutions only tends to occur when pressures from the outer environment challenge the intrinsically 'supply-based' institutional culture of these structures.

In advanced countries, there exists something that may be called a 'relationship web' linking actors such as the state, society and the research community that brings about institutional change. It works in a subtle, continuous and implicit way. In fact, the activity of this web often goes unobserved by researchers, and is thus considered as non-existent by many of them, or is perceived as a diffuse outer environment by others. This web fosters a process of reciprocal influences between the actors, disseminating values and establishing research priorities. This process locates 'fields of relevance' — the sets of problems that are the subject of the researcher's work — which require for their development, policy measures and resources. Research trends, resource-allocation norms and criteria, and specific criteria for 'quality' peer (or agency) evaluation are results of this process.

The economic and political interests of all the social actors involved in S&T activities in a given society at a given time — producers, consumers, funding agencies, or simply those who suffer its consequences — are represented in this relationship web. However, since it operates in a subtle, slow and incremental (but continuous) process, the historically and socially determined character of its results — the fields of relevance and the 'quality' evaluation criteria — is not perceived in this way. It tends to be understood as the 'natural' and 'logical' result of the scientific realm.

Nevertheless, the web contributes two characteristics to the 'quality' criteria currently formulated and adopted in the advanced countries for evaluation and foresight. It is inbred with respect to society, in the sense that it reflects conventional priorities accepted by researchers, though in a diffuse, unconscious manner. It is also dynamic, insofar as demands for new knowledge are continuously emerging from these societies, where S&T research has been summoned to solve the new problems constantly posed by the political and economic elite, with broad implications for national interests and (to a lesser degree) for social interests. Another way to describe this situation is to say that the web is responsible for the enforcement of socio-economic relevance as an evaluation criterion, which is the counterpart of the economic and political interests of the social actors involved in it, and which is even more basic than quality as it is usually understood.

Diverse actors, including entrepreneurs, the bureaucracy (or the state) and the scientific community, demand knowledge and call for the utilization of research outputs. The feasibility and the efficiency of using such outputs seems to be guaranteed by a mechanism based on two facets, the second being far more visible than the first. Since the usefulness and the application of outputs are guaranteed by the action of the relationship web, which enforces relevance, quality assurance becomes the only concern of the research community. As a consequence, quality is made out to be the necessary and sufficient condition for the diffusion of knowledge to the productive sector and for wider benefits for the whole society. However, there is also a necessary (though not sufficient) condition for a research activity to be considered acceptable: it must remain within the field of relevance located by that particular society.

The idea that quality of research is not only justified because it leads to the 'advancement of knowledge', but because its results will ultimately be applied to economic and social development, becomes a rationale to which it is difficult to object. In advanced societies, the social benefits of research are guaranteed by this mechanism. The same mechanism, acting in reverse, ensures that social development is included from the very beginning among considerations guiding research and the devising of quality criteria.

Thus, despite being central, the role of the research community in the S&T decision-making process is counterbalanced by the operation of the relationship web. As a consequence, STP becomes less biased towards the supply side, and the 'supply-based' institutional culture of the research structure (and the bias of the research community) can be more easily exposed to external pressures that promote institutional change and adaptation.

Since relevance is in some way guaranteed by the action of the relationship web, what is assessed by indicators is simply the quality of the research. As we shall see further on, if the satisfaction of relevance

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Factors influencing STP in Latin America

The role played by supranational institutions such as UNESCO (UN Educational, Scientific and Cultural Organization) in the adoption of the institutional model of the linear chain of innovation was decisive in Latin America. These institutions encouraged the adoption of the model, planting the idea of scientific progress in a rich soil already fertilized by a longing for modernization and development. The goal of various stakeholders was to emulate successful experiences in the first world through an institutional model that was unquestioned at that time. The scientific community, the civil and military bureaucracies, and certain sectors of industrial entrepreneurs were all engaged in this process.

Ideologically, what galvanized these actors was a nationalistic answer to the recommendations made by the established institutions in the advanced countries. The 'latecomers' argument was used to justify alleged advantages in technology transfer and the irrational nature of the nationalistic posture which defended the 'reinvention of the wheel'.

At the same time, economic policy recommendations based on emergent theories of national development were gaining ground in Latin American countries. They were based on a concept of development by stages and on the idea that dualism would be mitigated through the slow absorption of backward sectors by more modern industrial sectors. The transformation of a rural economy into an industrial one would only be possible through the transference of modern technology from advanced countries.

As in the S&T area, but stronger and more encompassing, the Latin American answer for economic policy was the import substitution model. This was conceived as a response to the development model based on raw material (agricultural and mineral) exports. The rationale of import substitution was based on the "deterioration of terms of trade" observed by the ECLA's (Economic Commission for Latin America) team. This was a powerful argument against the 'comparative advantages argument' raised by the theoretical mainstream which supported the recommendations made by advanced countries.

In Latin America, there were two factors that stressed the negative side of the supply-based institutional model. The first, widely analyzed, was the low demand for S&T from the productive sector, related both to the low technological intensity of raw material production for export, and to the manufacturing of products oriented to the internal market, for which technology is already available from the advanced countries.

The second factor, albeit determined by the first, which has not been sufficiently dealt with, deserves to be highlighted because of the central role it apparently played in shaping the STP/S&T indicator interface in Latin America. It is the nonexistence, or at most, the extreme fragility of the reciprocal influences between the state, society and the research community; that is, the precariousness of the relationship web in Latin America.

The process of socio-economic development which took place in Latin American countries has inhibited the establishment and functioning of this relationship web. Part of the weak social contribution of the results of research can be credited to faults which are not related to the demand of the productive system in itself, but to inadequate relations between the research community and the state and society in general. The relative distance of the American research community from socio-economic demands (compared to advanced countries) has acted as a brake to the incorporation of a 'substantive' relevance criterion.

Peer pressure from advanced countries and the subtle process of 'cultural colonization' has reinforced the adoption of an exogenous, 'adjective' criterion of quality, whose role has been disproportional in directing research.

Role played by research community

The role played by research communities in the design of Latin American STP exceeds by far the influence it has in advanced countries.

Some members of the research community, mainly traditional university disciplines) with power acquired through elitist mechanisms, have considerable influence in designing STP. These mechanisms transform prestige derived from academic activities, in particular disciplinary communities, into political authority and representational power.

What are the factors that enable some members of the community to act as spokespersons and participate in a privileged manner in devising the STP?

If it is true that the research community has an important role in designing STP in advanced countries, then in Latin America this is a leadership role. The combination of processes of logical, rational decision-making with incremental mechanisms of adjustment, typical of the decision-making process in advanced countries, takes on a distinct character in Latin America. Here it has been almost entirely incremental, leading to situations which only marginally differ from the *status quo* since things 'have always been done this way'.

Because of the virtual absence of other actors in the S&T decision-making process, which for the sake of simplicity can be attributed to the 'peripheral' or 'underdeveloped' character of the region, research community spokespersons have been the true designers, implementers and evaluators of STP, to a far greater extent than in advanced countries. This has

reached a hegemonic position in Latin America, more so than in advanced countries, where the relationship web consolidates and regulates demand, and for this reason, directs actions related to S&T.

Also, in Latin America, what can be called the 'density' and completeness of the relationship web, or the degree to which the different social actors are present in it, is quite distinct from what occurs in advanced countries. As a result, the role of research communities is more influential in determining the STP. Consequently it is also more difficult to counterbalance its bias towards reinforcing the 'supply' character of the policies. It is possible that the institutional model of Latin American research could hardly lose its inward-looking, supply-based characteristics, if a process of reinforcing the relationship web, similar to that which took place in advanced countries, had not occurred.

A simple explanation is that the Latin American S&T decision-making process takes place at the intersection of the scientific community, and civil and military bureaucracy, within an elitist environment marked by brutal social exclusion. The inertia and aversion to change, which is a feature of research institutions (and universities) that, for decades, had been immersed in that environment and, in many cases, submitted to authoritarian regimes that supported corporatism and insulation, is another factor.

Orienting research and S&T indicators

The construction of indicators plays an important role in the implementation of 'quality' criteria — the only ones, as outlined above, that seem actually to exist. Indicators are necessary to generate inputs for decision-making and resource allocation. Among other considerations, in advanced countries and, with less legitimacy, in Latin America, quality is inferred from, and research is orientated by, these indicators. The contrast outlined above between advanced and Latin American countries shows the mirroring, imitative characteristics of the process involved in determining criteria for planning and funding research in Latin America.

After having adopted the linear chain institutional model, Latin American countries began to produce indicators specified by the same institutions that promoted it locally. Insofar as our S&T systems followed the institutional model and adopted the corresponding criteria of advanced countries, they also had to follow their pattern of indicator production. Whereas in advanced countries S&T indicators have given rise to policies reflecting national priorities and, ultimately, economic and social demands for knowledge, in Latin America their production has tended to be a mere exercise, frequently innocuous.

Traditional indicators may only shed light on the distance separating us from the models and criteria we adopt. Or, at best, they may show what the actions should be that could narrow the gap. The problem is that, even more than in advanced countries, a new and original institutional model of STP is needed in Latin America to cope with our situation. Technological trajectories, responsive to internal socio-economic priorities and to the comparative advantages we have and should undoubtedly exploit, cannot be determined with the traditional, imitative pattern of STP adopted until now.

There is a considerable task ahead for STP analysts and, particularly, for specialists in S&T indicators. The transformation resulting from what may be a new Latin American STP perspective, centered on the satisfaction of social demands, poses new demands for indicator specialists. As often happens, the challenge ahead of STP researchers in Latin America is even more difficult than it is for advanced countries. We are forced by the very nature of our social problems, and by the lack of time available to solve them, to adopt a more incisive and detailed style of decision-making in S&T. One of its characteristics is that it should make the different visions and priorities of existing social actors explicit. In addition, the weak signs given by the demands of society and by the 'market' itself to the Latin American S&T system make it necessary to highlight the interests and actors currently under-represented in the system.

In short, essential transformations in Latin American STP are not of an incremental nature. A quantum leap demanding a rational approach is required. This approach should start from the assessment of technological demands posed by the scenario of economic democratization, in order to define the outline of the STP to be implemented and the S&T indicators it requires.

In the present adverse S&T climate in Latin American countries, with considerable lack of direction in innovation policy, it is necessary, before outlining suggestions for new indicators, to consider the prospective scenario envisaged for Latin American countries. Only when this is done is it possible to propose indicators that will serve our purpose.

Economic democratization as a framework

The strategic vision, which must necessarily govern any effort in S&T, demands a long-term perspective to highlight elements which transcend economic and

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political directions whose life-cycle is shorter than that of S&T. This new STP perspective is supported by the scenario of economic democratization, which will follow the political democratization that started more than ten years ago in Latin America. Economic democratization will involve productive and technological demands which only a concentration of S&T potential can solve in the near future.

In Latin America, research potential must be applied to those new technologies which will address the problems of socio-economic development. Given their unique nature, this could give rise to an internalized, self-supporting, innovative dynamic and the exploitation of significant external and internal economic spaces.

There is a need to reconsider and position ourselves with respect to the old and tricky discussions about the trade off between policies 'of ' science and 'for' science. More specifically, the expected social transformations reveal the advantage of adopting anticipatory policies that, without disregarding the role played by mutual adjustments among parties, provide greater rationality to decision-making and ensure stricter consistency with national goals. This involves a methodological challenge for those responsible for developing and implementing innovation policies, because there are no theoretical or historical reference frames that may shed light on the implications of economic democratization within an innovative environment.

What will be the impact on the economic and productive fabric of changes in consumption patterns resulting from economic and social transformations? What will be the technological demands derived from this new socio-economic pattern? What is the priority of technological demands from different sectors and how should they be included in a policy that does not ignore a wide range of alternative instruments and actions? To answer these questions implies a more thorough diagnosis of the present situation.

The scenario of economic democratization should aid internal social integration. This should lead to increasing demands for mass consumption goods through direct and indirect redistribution of income. Despite the heterogeneity of the industrial sectors producing such goods, most enterprises involved are small and domestically-owned, are not technologically intensive and tend to be inefficient. Their technological progress, as influenced by economic factors, results in a slow pace of innovation.

The expansion of the S&T frontier in the advanced countries has been different. These countries, with a relatively wide distribution of income and large, well-established markets, based their economic growth on the satisfaction of increasingly sophisticated demands. Sectors satisfying such demands are the most dynamic from an economic viewpoint and, therefore, concentrate most of the private R&D resources.

The 'high tech' goods, which initially reach just the high-income segments, are rapidly diffused through all society, due, in part, to the impact of the learning 'S-curve', and also because of reductions in price through economies of scale. In addition, the benefits of economic growth tend to be evenly distributed in advanced countries because of their relatively homogeneous income profile. The resultant pattern of S&T development became biased towards the demands of the upper classes of the richer countries. Science frontiers have been consistently expanded to satisfy these demands.

The Latin American population, which on average has an income seven times lower than in advanced countries, is not able to afford these 'high tech' goods. The introduction into Latin America of innovations produced in the advanced countries has had only a slight effect on the well-being of the overall population. In Latin America, an increase in the growth rate of sectors devoted to mass consumption goods might lead to a rather different pattern of S&T development. In other words, the sectors enhanced by the economic democratization scenario could build a new dynamic in the exploration of the S&T frontier.

Economic democratization presents an important technological challenge. In an extreme case, such as Brazil, where it is estimated that 50% of the population is on the economic fringes of society, the creation of such a consumption market would mean, metaphorically speaking, the creation of another Brazil (with consequences in terms of telecommunications, roads, energy, food production and housing).

To date, satisfaction of social demands has been widely accomplished through outdated and inefficient technologies. This should no longer be accepted as an inexorable fact, but merely as a temporary situation in Latin America, a region that has the capacity required to overcome it. A substantial portion of production and employment in Latin American countries is absorbed, and will be even more in the future, with satisfying social demands. Hence, any change in the associated technologies, be it in productivity or impact on the social fabric or the environment, will act as a spur for further changes.

It is important to note that, while in the sectors that cater for high-income consumption the probable expansion route of the technological frontier is known, or could be learned from monitoring trends in advanced countries, in the case of the sectors of mass consumption, there are no visible technological paths.

For the mass consumption goods sectors in Latin America, frequently there will be no choice: even if we wanted to import technology, we might not find the proper technology to import. Hence, we should assign our potential for research and training human resources to generating efficient technologies to solve these problems. While the same scientific and technological knowledge which increases efficiency in the mass consumption sectors in advanced countries, can be used, it still must be 'engineered', to cater for the demands of the Latin American reality. This must be brought about urgently, before the expansion of the mass consumer market created by the scenario of economic democratization.

Scientific, technological, economic and social policies should converge in a strategy to reduce inequalities, acting on areas of less political resistance where the public sector is able to play a more effective role. State policies fostering technological development in areas where it is directly responsible for satisfying the population's demands should be exploited in order to increase productivity, where its immediate positive impact will be greater and where social development can be guaranteed.

Obviously, this transformation is not necessarily limited to the internal market. Research aimed at satisfying social demands can, at the same time (and through the differentiation of products) generate new market opportunities. Far from having a nationalistic, internal-market bias, this strategy points to development and cohesion of the national innovation systems in Latin America, transforming social demands into inducement of customer-driven innovations which consolidate local socio-technical objectives.

Critique on production of S&T indicators

At the beginning, we commented on the relative success of cooperation in this area at this juncture in Latin American development. In the various discussions and activities that have developed in the region, it is possible to observe some particular dynamics. The first is linked to the imitative tendency already mentioned, in the sense of producing 'traditional' or 'old' indicators, and the 'new' indicators of innovation recently devised in advanced countries. It could be said satirically that the slogans are "at least the *Frascati Manual...*" and "at least the *Oslo Manual...*".

A short explanation of these caricatures is necessary. The voices which demand indicators on the scientific productivity of our communities, be it of output — linked to scientific publications — or input — related to the training of human resources S&T investments — raise the flag "at least the *Frascati Manual...*". Despite the critical tone in which these demands are at times made, for example, in relation to the bibliometric bases used, they remind us of similar statements made in support of the linear supply-based model. Even though indicators should adapt to regional characteristics, according to these voices, the necessary information bases must be coherent with those used by their peers in advanced countries.

Another group of demands comes from researchers in innovation economics, where the lack of indicators is most evident. This group seeks to verify, in Latin American countries, the causal models of innovation which have been applied in advanced countries. For this reason, they raise the slogan "at least the *Oslo Manual...*". Indicators at the micro or entrepreneurial level, where, according to innovation theory, not only innovative activity but also the very determinants of innovation are concentrated, are indispensable to this group. These innovation indicators leave aside aspects referring to the relationship between the actors, or to what we have referred to as the relationship web, which is increasingly considered as an irreplaceable factor of competitiveness.

A second dynamic, separable from the first only in analytical terms, relates cooperative activities on this theme in Latin America to the stimulus to carry out new programs such as devising further indicators which demonstrate the utility of these data to the organizations responsible for their production at national level. The objective of this activity in devising and experimenting with appropriate indicators for Latin American STP is to trigger common processes relevant to nations in the region.

The adoption of the perspective of an STP based on the scenario of economic democratization demands the addition of a third dynamic. It is inefficient to start off with a posture of trying to fulfill the objectives of "at least Frascati' and "at least Oslo" only to later worry about devising policy-oriented indicators. Indicators coherent with the economic democratization scenario must be devised. This route, together with the development of a capacity to interpret the indicators with a view to devising STP, seems to be a better strategy.

The reactionary position, which appears from time to time, of diminishing the gap which separates us from advanced countries in terms of indicator production, seems inadequate. These indicators, in fact, portray a past context based on the Cold War rationale and the support that the military establishment gave to S&T. It is necessary to establish an activist position which innovates in the direction of specific demands posed by our situation. The shaping of STP cannot fail to reflect this concern. Besides trying to portray a given reality, the new indicators must support reliable interpretations of this reality, so that the decision-making process, which is inherently based on politics, and not just policy, can take place in an increasingly effective way.

In the same way, as with other public policies, the development of STP is not based on information nor the indicators themselves, but rather on the actors' perception of a reality which the indicators somehow try to express. For this reason, it is necessary to describe a new direction for research into indicators, guided towards devising distinct parameters (so as to avoid using the expression indicators). Transcending the real stocks and flows of S&T, these parameters must be directed in a systematic way to introduce the perceptions that the different social actors involved have of the future into the decision-making process.

This seems to be a condition for the increase in the density of the relationship web, which is increasingly considered to be what is principally lacking in the developing innovation systems in Latin America. Only in this way will the emergence of a decision-making process, which is more participative, transparent, and consistent with the demands of the majority of the population, be possible.

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