Universities and the development of scientific and technological research in Mexico: a research agenda

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Resumen

La retórica universitaria menciona a la investigación científica como una de sus funciones substantivas, muy pocas universidades lo hacen visible en la asignación de recursos. Los indicadores de referencia que publican son sólo de carácter docente. Así, el conocimiento de cómo se desarrolla la función de investigación en las universidades públicas es exiguo y las decisiones institucionales en este ámbito ocurren en el vacío. Presentamos una panorámica y planteamos una agenda tentativa de investigación que permita desarrollar estudios que desemboquen en conocimiento acumulable y capaz de soportar y fundamentar decisiones de directivos de la educación superior encaminadas a sacarla del marasmo en el que se encuentra.

Palabras clave:

- Investigación científica
- Asignación de recursos
- Ciencia y tecnología
- Función substantiva

Abstract

The university rhetoric portends scientific research as one of its substantive functions, few institutions translate this into the actual allocation of resources. The benchmarks published refer only to teaching. Thus, knowledge on how to develop the role of research in public universities is scant and institutional decisions in the area happen in a vacuum. We present an overview of these issues and propose a tentative research agenda to develop studies leading to cumulative knowledge that could enable to inform and support management decisions in higher education aimed at lifting research out of the standstill it is in.

Key words:

- Scientific Research
- Resource allocation
- Science and Technology
- Substantive role

The social and economic value of science and technology

The economic and social value of knowledge has been widely recognized, cultivated and managed for decades in countries with greater economic dynamism. From efforts to use scientific and technological capabilities that allowed the Allies to win World War II (Bush, 1945), to the successes of countries like Korea, China and Brazil in the economic development of new capabilities based on knowledge, governments invest systematically in this area, and encourage their universities to actively participate in it.

Internationally, knowledge is currency, because by itself it is capable of generating economic opportunities and attracting capital and industry to generate more wealth. Countries that are aware of this develop explicit policies and programs to attract and retain human capital from less developed countries, while countries like Mexico are sending scholars abroad, dismantling their own programs of repatriation for researchers and freezing the research chairs in universities and public research centers.

In Germany, the Netherlands and other European countries regional universities negotiate their budgets with governments and local business communities on the basis of the impact of their activities on the local economic growth (Benneworth *et al.* 2009, Heher, 2006, Clark, 1998 ; Lazzeretty and Tavoletti, 2005, Bird *et al.*, 1993). Countries like Canada are seeking to develop models and policies to obtain economic returns from university research (Langford *et al.*, 2006, Bacchiocchi and Montobbio, 2009). Researchers around the world have developed sophisticated methods to measure and model the impact of investment in science and technology on innovation and economic growth (Heher, 2006, Jones, 1995; Arechavala *et al.*, 2010; Berman, 1990).

In the international context, for fifteen consecutive years, Mexico has been the OECD member country that invests the least in science and technology (OECD, 2008). Labor productivity is almost the same as it was in 1991[1] and the continued loss of competitiveness still fails to attract the attention of officials and institutions on the need to invest more resources in research.

The term "knowledge society" should certainly be much more than rhetorical phrases in the official discourse. Nevertheless, there are no visible, coherent measures and programs to develop scientific capital, research infrastructure and significant knowledge bases in academic and economic contexts, therefore we are not in a position where we can apply such a term in our society.

[1] Data available at: http://stats.oecd.org.

Scientific research, is it a "substantive function" in Mexican universities?

The model Mexican universities follow belongs to the nineteenth century. The medieval universities were essentially teaching universities. Research universities emerged in the early twentieth century in the United States and Europe, but German universities were already contributing to the chemical industry, solving problems and developing new technologies since the nineteenth century (Atkinson and Blanpied, 2008).

The social function of universities is changing in an ever more widespread fashion (Owen-Smith, 2002). They have gone from being repositories of knowledge and culture, to forming professional cadres. Hence, some became research universities, accumulating not only great knowledge capital, but research capacity: in developing infrastructure, institutional conditions and solid research bodies (Arechavala and Diaz, 1996), for example.

Now some of those which drove the transition to research model universities took another step, and became economic actors in the knowledge society, becoming an energizing element of economic activities at regional and international levels by the direct marketing of knowledge (Goldfarb and Henrekson, 2003; Lofstad and Lindelöf, 2002, Mansfield, 1998, Powell and Reed, 1995, Salter and Martin, 2001; Thanki, 1999, Van Alstéd and van der Sidje, 1998), and not just as trainers of professional cadres. Not all universities that have tried this achieved the same results and levels of efficiency in the commercialization of knowledge (Anderson *et al.*, 2007). Deliberate change efforts are required, aimed at developing specific skills (Rasmussen *et al.*, 2006, Chapple *et al.*, 2005, Siegel *et al.*, 2003; Franzak and Arechavala, 2010) and a prior accumulation of knowledge capital plus a significant research infrastructure (Arechavala, 2010).

Universities that develop these capabilities also profit, in many ways, from the economic benefits generated by knowledge. While the sources of knowledge generation have diversified greatly in the more advanced economies, universities are still the center of the networks that produce it (Atkinson, 1997, Etzkowitz and Leydersdorff, 2000, Godin and Gingras, 2000; Dahlstrand, 1999; McMillan *et al.*, 2000). However, in Mexico and Latin America changes in that direction are not only delayed, but stagnant (Sutz, 2000), and in some cases even regressing.

Since the last two decades of the twentieth century entrepreneurial universities have taken hold in developed and in some emerging economies: those that hold and profit from the wealth generated by knowledge, and create the technologies that account for roughly 65% of the economic growth in the regions where they operate (Atkinson and Pelfrey, 2010). Discussions, performance evaluation, their essential problems and their anchorage in the university research capabilities abound in the international specialized literature (Martinelli *et al.*, 2008, Bramwell and Wolfe, 2008, Wong *et al.*, 2007; Lazzeretti and Tavoletti, 2005, Etzkowitz, 2003; Clark, 1998).

However, Mexican institutions have remained in the dark during the transitions into the research university, and thence into the entrepreneurial university. Our universities by default, inertia and mandate are still teaching institutions.[2]

Mexican universities are inertial systems: what has been done in the past sets the tone for what will be done in the future. Since this situation is widespread in the country's institutions, it seems normal to everyone.

But if a university can boast about doing 50% of the research in Mexico (even if that were true) despite how absurd and abhorrent that statement may be, it demonstrates the country has a serious problem in the ability its universities have to evolve and adapt, as well as a manifest inability to understand the value of science and technology, and the role that universities play in their development.

It has traditionally been considered that the essential or "substantive" functions of higher education institutions to be teaching, research and cultural outreach. This is part of the daily rhetoric, parroted in countless speeches and documents. However, this rhetoric coexists with the statement that "the essential role of universities is teaching". Nobody seems to be troubled by the fact that teaching without research is a diluted sterile repetition of knowledge, obsolete, consulted in books written by authors, mostly foreigners.

Under this paradigm, the idea that the student could be able to be trained by researching and through research just makes no sense. Universities in Mexico and Latin America remain for the most part, without significantly developing research, ignoring the impact this has on the quality of teaching and the ability of the university to directly contribute to the economic and social welfare of the region in which it operates.

In Mexico there are few cases of HEIs with significant achievements in consolidating research, which for many it justifies continuing disproportionately concentrating resources in just a few of them. Perhaps one of the most startling indicators of the heterogeneity and inequality in the development of the country's universities, as a result of such concentration of resources, is the agglomeration of active research groups and members of the National System of Researchers (SNI) in just a few institutions.

This is, of course, no accident. The problem arises from the very way we conceive the course of developing these institutions. In the best universities in the world, for example, selecting candidates to fill the highest positions is approached with a national or international scope, seeking those with the most experience and potential to foster the institution's development. For the designation of the highest university authorities in Mexico, seeking individuals with proven ability at the national level (in the development of institutional research function, for example) is not even an option. These positions are sought from within the organization, regardless of the level of preparation applicants may have for the task. The career paths that lead to

[2] Lets remember how, in recent administrations, deliberate policies, operational guidelines and funding mechanisms favor the teaching paradigm.

these positions are based on the formation of alliances and internal clientelism, and are traditionally poised to move ahead in the local government administration, if not entirely reserved for the local power elite. This creates an institutional inertia and the prevalence of the status quo, and encourages the political use of academic power (Arechavala, 2001, Arechavala and Solis, 1999). On the other hand, in our medium scholars tend to shy away from leadership, leaving its development in the hands of more politically oriented staff members, with little vision and no understanding of the dynamics of science and technology.

Rarely university authorities consider the development of institutional research capabilities as, at least, part of their responsibilities. Whenever they do, they tend to understand it in bureaucratic terms: it means "supervising" or, worse, regulating these activities, subjecting them to operational and administrative decisions that affect research coming from people with no ability whatsoever to perform it or to understand its needs. The true cost of this to the country and the universities is apparently invisible, but significant in terms of human capital development and knowledge generation capacity (Eisemon and Holm-Nielsen, 1995).

Government policies in the area of promoting research in universities have included a series of programs and tools that assume that bureaucratic control of this function is sufficient: i.e. the Teachers' Improvement Program (PROMEP) and the centralized opinion of what constitutes a "consolidated" academic body, show graphically how the use of paperwork and simulation hide the failure in promoting real development of research institutions (Gil, 2000). Virtually all of the incentive programs are focused by simple inertia, in strengthening teaching, under the paradigm that delineates the official capacity building programs for higher education funding.

On the other hand, when the aim is to promote scientific research beyond speech in public universities or research centers, resources tend to be nominal and their use ineffective. The absence of a deep understanding of scientific activity and its institutions, how they respond to cultural values and economic imperatives, and how they have developed historically, has led to copying other countries' approaches and trends, with an utter ignorance of their fundamental contents. The bureaucratic mentality suggests that some mechanisms to implement registration and counting of "academic bodies", for example, would set academic staff in collective research dynamics, that would be the equivalent of 'invisible colleges' and international research communities.

The HEIS faculty is aging, mechanisms to promote its renewal favor teaching and seniority as means for accessing retiring staff seats. Generations of Mexican scientists that study abroad remain and make their way elsewhere, while those in Mexico tinker with the possibility of leaving the country.

Change in universities, in regard to the development of new organizational forms, and particularly in advancing research, faces significant obstacles in two orders. The first, institutional, in that it limits the range of options that university authorities consider when weighing the possibility of modi-

fying the design of the university organization, as well as operational and strategic guidelines emanating from federal desks, reducing the problem to the imposition of indicators that determine resource allocation. University authorities devote their efforts to the pursuit of these indicators, and consider themselves fully relieved from their responsibility of defining their own institution's direction and development model. Research itself is reduced, i.e. to the registration and accounting of SNI members and "paper academic bodies", disregarding the dynamics of variable interaction between productive researchers in real life.

The second set of factors that limit the possibility of change is cultural, university leaders have no visible references of organizations devoted to successful scientific and technological research, and the social and economic contributions it generates.

This problem is also exacerbated by the fact that scientific and technological societies in Mexico have not yet had the relevance that would enable them to promote research development. Their number, membership and vitality have fallen very short. In Mexico they have failed to perform the role that for centuries has been performed in other countries (McClellan, 1985). They have not developed a significant role as forums and peer review systems that regulate the development of science and technology from within their own scientific and research communities, so this function remains in the hands of organizations like the SNI , which invariably must apply stiff and mechanical criteria.

For decades, sociology of science has very well established the fact that researchers' professional references are external to the organization (Hagstrom, 1965, Merton, 1973; Crane, 1969). Genuine researchers regulate their work by what is happening in their field's national and international communities, not by the bureaucratic dictates from the organization where they happen to work. The scientific community's norms and values are what determine individual careers through "invisible colleges" (Crane, 1969). This means that universities should do little to "monitor" their research staff performance, instead they should focus on creating an enabling environment to attract talent and then promote its development.

What are the prospects?

As a result of these processes, among others, the development of research in HEIs has dropped to a second or third place in terms of priorities. It is not part of the agenda in the relationship between rectors and authorities, nor part of government officials' concerns or non-governmental higher education governing bodies, nor for that matter, the Congress's or the Executive Branch's.[3]

In case there was deliberate effort to start to move toward the model of research universities, we would be confronted with huge gaps in the knowledge required to achieve this successfully. There are many questions to be answered by systematic research in order to understand the processes responsible for the advancement of scientific research as a university function, as a social institution and as local, as well as universal, knowledge communities.

What has been the real effect of programs such as PROMEP, the Roll of Excellence, the Program for Institutional Strengthening of Postgraduate Studies (PIFOP), the Integral Program for Institutional Strengthening (PIFI), etc., in the configuration of faculties, resources and organizational profiles dedicated to graduate and research programs?

What are the main constraints, resources, and opportunities for it? Is our science and technology policy appropriate to induce such changes? Should universities take the initiative to influence the modification of existing policies? How do Mexican science and technology policies compare to those of other countries? What does this imply for economic and social development, and knowledge generation in universities and research centers?

Given the fact that the importance of social investment in the generation of knowledge is accepted by virtually all countries, and in Latin America research initiatives have proliferated, hence, many countries have surpassed Mexico in this regard. Therefore it is relevant to outline what could be the blueprint for a research agenda in the processes that determine the advance of science and technology in Mexico. The intent is that the understanding derived from systematic research in these fields could result in the intelligent investment and actions to increase research capacity in universities and public research centers. Together with political will on the part of the authorities, this venture will require a clear understanding of the processes and variables that determine the development of institutional and organizational capabilities necessary to advance scientific research in the country. In our medium, few are the studies and researchers dedicated to this subject. Therefore here we propose some components for a research agenda that identifies the issues of which we lack the necessary knowledge.

[3] A stark example can be to simply think of the percentage of GDP that the federal budget allocates for investment in science and technology, or the federal and state executive branches' intentions to further reduce the budget allocated to universities and research centers. This picture makes us think that change must originate from within the universities themselves, and from the study of processes relevant to them, instead of hoping it will come one day from fairly enlightened public officials.

The dynamics of research and research training within the universities

Research is a difficult task in our medium. Universities still have little idea on how to promote this activity.

- What organizational modalities have those HEIs –which have managed to consolidate the role of research– adopted and how have they achieved it?
- To what extent is it a function in which its development responds to structural elements in the organization, i.e. the quality of human resources assembled, the favorable conditions for the development and the productivity of teams, etc.? Is there an awareness of these processes among the university authorities?
- Are there visions and institutional projects on the role to be performed according to the country's needs?
- What changes or decisions should be made by university and research center managers in order to build research capacity?
- What changes and decisions must be made on the path for institutional development to build infrastructure, productive research teams and knowledge bases that may be a hotbed for economic opportunity?
- What are the features of the most successful postgraduate research training programs?

Statistics of research development in public universities and research centers

What is the general overview of the development of research in public universities, based on statistical analysis of data published by universities or the ANUIES (i.e. statistical yearbooks)? What are the productivity patterns of scientists from public universities and research centers? Can its impact on local economic development be assessed with some objectivity?

Among the important issues are: the analysis of the heterogeneity between institutions as well as their research capabilities and paths that have led them to develop such capabilities, it will also be valuable to identify the main patterns of successful development that have risen in the development of this function.

Longitudinal analysis of data published by the CONACYT

The statistical yearbooks published by the CONACYT (National Council for Science and Technology) represent an interesting opportunity to understand the trends in the development of science and technology in Mexico. There have been few attempts to seriously analyze these data to identify patterns and leverage points in the behavior of key variables and to identify the effects that the main policies implemented, since the publication of these directories, have had on these patterns. The analysis of these data may also help identify

the disparities in stages of development putting into perspective the state of research in HEIs and research centers in Mexico.

For example, the longitudinal analysis of the behavior of the scholarship program abroad, compared to the recruitment of research staff in universities and research centers, may help quantify the absorption capacity of qualified human resources. Another example is the evaluation of the results of a researcher repatriation program, departing from the resource endowment that universities manage to obtain from it.

The country's competitiveness and its relative position in the OECD

Interest should be placed in identifying the main patterns of development in Mexico's science and technology indicators in a comparative context with other OECD countries, and with the rest of Latin America as well as with other emerging economies. It would also be interesting to compare the relative performance of public and private investment in research in different countries, with special attention on the role played by universities and public research centers.

Particular emphasis may be placed on the analysis of the impact that investment in science and technology has on economic development and the creation and transfer of knowledge, economic opportunities, tools and processes for Mexico to shape a positive policy change in this area. Do universities make, or could they make, a significant contribution to the development of Mexico's innovative capacity and competitiveness?

The role of scientific and technological societies

In Mexico, few scientific and technological societies have managed to maintain a trajectory devoted primarily to the development of their disciplines. Their role in the development of science and technology has been blurry and with little visibility. Which are the main and most active societies? How are their leaders conceiving the development and future prospects of their disciplines? Is it foreseeable to attain a level of maturity reflected on roles such as those played by their counterparts in other countries? In the Mexican case will it be fundamentally different roles, or will they remain absent from this process? How are these societies affecting the development and the role of government policies aimed at influencing the development of research in universities (PROMEP, PIFOP, etc.) and research centers? How shall their interactions be articulated with other stakeholders: government agencies, universities, etc.?

Description of the components and dynamics of science and technology

The different institutions, programs and processes that conform the system of science and technology in Mexico have recently experienced major changes. The roles played by stakeholders (i.e. particularly the role of CONACYT itself, the Sectorial and Mixed Funds, the Law on Science and Technology) have undergone significant transformations. Universities and public research centers have suffered the implications of these changes, probably without having taken the active role that might be expected from them. It is necessary to enumerate them, to be able to map the configuration of the system and to identify the key dynamic processes taking place and future trends. As well it is necessary to devote particular attention to the role that universities and public research centers play and may play in this process. This issue may include the analysis of institutional contexts in which the interaction of universities and research centers with other organizations takes place, and hence facilitates or impedes the development of research.

Science and technology policies in Mexico: historical and future perspectives

The Special Program for Science and Technology 2001-2006 became a dead letter, there was nothing institutions responsible for implementing it were able to do about it. A critical, yet constructive analysis of the policies that have influenced the development of scientific and technological research in Mexico, at the universities as well as in public and private research centers, is imperative. Especially interesting is the identification of key policy instruments (financing, laws, programs and federal or state plans) that have had the greatest impact. It is required in this area to generate knowledge based on objective and direct evidence, but secondary data analysis it is also necessary. Probably one of the areas where the most imperative need for systematic research is in the comparative analysis of Mexico's science and technology policies with other countries. What has been successful in emerging economies and the more advanced countries in Latin America? What are the main barriers present, perhaps in common with Mexico, to promote science, technology and innovation? What is the role universities play in these countries?

This thematic issue focuses on research aimed at understanding and demonstrating, based on evidence, the processes that determine the relative success that HEIs and public research centers have in the development of scientific and technological research in Mexico, as well as the organizational forms that been more conducive for it, and assessing its context and future prospects.

Rigorous scientific research on these issues is still scarce, however, the works included in this publication already represent significant contributions, that point in the direction of the themes proposed in this agenda.

Guadalupe Moreno Bayardo makes a clear exposé of some student training cases that reflect both the advisers and graduate programs shortsightedness in supposedly training students. It is clear that in many institutions form prevails, and contact with substance is hence lost. As the author rightly points out, in the practical training of research students graduate programs primarily pursue the achievement of goals associated with centrally defined indicators, and essence is lost in the process, which should instead be directed, for example, to the incorporation of new researchers into international research communities. The analysis of the institutional conditions that Moreno Bayardo makes, clearly shows, by contrast, the gaps to overcome, or the skills to be enhanced, if the effort to develop research in universities is to be taken seriously. The evidence presented and articulated succeeds in showing the importance of the institutional context that shapes the interaction of the different stakeholders in the process of training researchers, the actions of each of these actors and the roles they play. While the analysis was made for the case of a specific researcher training program, it is clear that it unveils important implications for the training of researchers in many disciplines and institutions.

The research training process is also studied in the work by Veronica Ortiz Lefort. She also addresses the institutional factors that shape the formation and development of researchers. Although the tone is rather impatient (and fully justified) about university authorities and politicians who claim to lead the development of science and technology in Mexico, the author raises very relevant ideas and arguments about the impacts of their ineptitude on the development of science in the country. It is interesting to note that the very attitude that researchers interviewed show also reflects the difficulties they face when trying to perform their daily tasks, given the poor working conditions offered by universities.

Looking rather to determine the effectiveness of the process, the work by Candelaria Ramirez, Mariana Reyna, Aida Garcia, Xochitl Ortiz and Paul Valdez also addresses the training of researchers, although focusing more on evaluating the outcomes. From a quantitative perspective, their work gives a clear indication of this process' limitations in Mexican universities. The criteria used to operationalize the successful training of researchers seems at once simple, elegant and sleek, but the results are disappointing, they reflect a serious limitation on the capacity of our institutions to train researchers. From their results, of course, many of the authorities in charge of Mexican universities, and of their graduate programs in particular, could derive important implications to better their work. Among other things, the authors' proposal can probably even be used in place of other sterile indicators currently in use for graduate programs quality assessment.

But trained researchers productivity depends not only on their training and personal characteristics. The organizational and institutional context in

which they work strongly determines their patterns of productivity and job satisfaction. Ana Isabel Metlich and Ricardo Arechavala present an investigation based on a comparative analysis of the conditions of scientific production in two organizations: a university and a public research center. They identify common processes in both, but also specific differences arising from the perception of researchers interviewed and the strategies they pursue in order to develop their scientific careers under conditions that are far from being the most favorable. Again, this universe should be known and regularly frequented by those in leadership positions in science and technology organizations, and by decision and policy makers in this field at the federal and regional level.

The work by Alejandro Mungaray, Jorge Ramos, Ismael Plascencia and Patricia Moctezuma explores the possibilities for institutional change in universities, in response to strengthening their capacity to contribute to economic development through knowledge generation. It also emphasizes the essential character that their interactions with other actors in innovation networks have in the process. In fact, the role of universities and research centers not only changes according to the dynamic of knowledge production, but also changes course on the basis of the demands made by other social stakeholders. The response to these demands requires authorities to have the capability to rethink the mission and vision of their institutions. While this paper applies the concepts to the context of Baja California, it is clear that universities in all regions of Mexico need to start changing their orientation, speech and deed, in this direction. These authors give their article a regional perspective focus, which its importance is internationally recognized, only at a regional level may and should the role of various stakeholders in innovation systems be reconfigured, to adapt its performance to the needs of the region, as federal policies tend to lose sensitivity to local needs, while they aim to address the main national medians. A significant portion of the value of the perspective presented by these authors arises from the vision that put the role of universities among all the activities of knowledge generation which are becoming increasingly diversified, forming a coherent and coordinated set of efforts for achieving regional competitiveness.

On the other hand, apart from understanding the organizational and institutional contexts in which scientific activity is developed, it is important to understand the dynamics and products generated by the system at the aggregate level. The article by Guillermo Campos Rios and Maria Eugenia Martínez de Ita provides significant guidelines to reflect on how the development of scientific research in Mexico has been, and remains, centralized in its dynamics. According to the authors, this is the result, among other things, of administrative mechanisms focused on indicators. Resulting in a more marked inequality (the "Matthew effect") in the research capabilities of different states and in the universities themselves, leaving the weakest unable to compete for resources with the already most favored states and institutions. According to the authors, this excessive concentration is detrimental to the development of the whole system, hence they call for the development

of more enlightened policies knowledgeable of the dynamics of research in the country.

From the perspective of science as an activity and social function, Santos López Leyva analyzes the visibility of Mexican scientific knowledge through the analysis of the participation of Mexican journals in scientific data banks, and by studying the publication of articles by Mexican scientific researchers. His analysis of the presence of Mexican journals in data banks is interesting and shows a perspective, which typically is not at a glance for individual researchers or institutions. Apart from the interest this may generate, derived implications from the access to knowledge systems and the options that this opens for the development of research in universities are also fecund. This is one of the few studies that exist in our country about the generation and dissemination of scientific knowledge. By taking a perspective and analysis beyond what is visible for individual actors, it makes a contribution that is both important for science and technology policy in the country, as well as for particular institutions and researchers.

Studies such as those included here should be regular reading material for university authorities and organizations devoted to the development of higher education, science and technology. The findings of authors contributing to this thematic issue are again an indicator of the need to better understand the processes of the development of science in Mexico, increase the resources devoted to this area, and implement smarter policies.

Nevertheless, it is clear that these authors contributions are only an initial step in the generation of knowledge needed to trigger a breakthrough in the evolution of scientific and technological capabilities in universities and research centers. There are huge gaps in our understanding of the processes that determine the development of a significant knowledge basis for economic development. It is still surprising that Mexico is not part of the international community that conducts scientific research on these issues, that Mexican researchers do not cite works from international journals in the field, and moreover that Mexican researchers are not cited by researchers from other countries.

It is important to unleash the systematic investigation of factors and processes such as those referred to in these pages, so that our institutions can evolve toward being more modern and internationally competitive, and so that authorities are able to design and implement smarter policies in this regard. The blindness of those who so far have designed these policies has put Mexico in a position of being not only behind, but virtually stagnant in the field of science and technology. Our businesses, our scientists and our universities compete with their peers in other countries, and the speed with which they move leaves us increasingly in a more helpless situation. Neither the researchers nor the universities can continue waiting for change to come from the center. For this is increasingly unlikely.

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