

THE POWER OF TECHNOLOGY*

Simon Schwartzman

*Centro de Pesquisa e Documentação em História Contemporânea do Brasil,
Fundação Getúlio Vargas, Rio de Janeiro*

TECHNOLOGY GENERATION IN LATIN AMERICAN MANUFACTURING INDUSTRIES. Edited by JORGE M. KATZ. (New York: St. Martin's Press, 1987. Pp. 549. \$39.95.)

NORTH-SOUTH TECHNOLOGY TRANSFER: A CASE STUDY OF PETRO-CHEMICALS IN LATIN AMERICA. By MARILUZ CORTES and PETER BOCKOCK. (Baltimore: Johns Hopkins University Press, 1984. Pp. 176. \$25.00.)

THE POWER OF IDEOLOGY: THE QUEST FOR TECHNOLOGICAL AUTONOMY IN ARGENTINA AND BRAZIL. By EMANUEL ADLER. (Berkeley and Los Angeles: University of California Press, 1987. Pp. 398. \$45.00.)

NATIONAL POLICIES FOR DEVELOPING HIGH TECHNOLOGY INDUSTRIES: INTERNATIONAL COMPARISONS. Edited by FRANCIS W. RUSHING and CAROLE GANZ BROWN. (Boulder: Westview, 1986. Pp. 247. \$26.50.)

THE UNITED STATES AND MEXICO: FACE TO FACE WITH NEW TECHNOLOGY. By CATHRYN L. THORUP AND CONTRIBUTORS. (New Brunswick, N.J.: Transaction Books, 1987. Pp. 224. \$19.95 cloth, \$12.95 paper.)

What can technology do for the development, modernization, and well-being of Latin America? How is technology acquired, generated, and incorporated in countries without a strong technological tradition? What are the roles played by private firms, state enterprises, state bureaucracies, and multinational corporations in this process? How can the various social sciences contribute to the understanding of these processes and to the shaping of suitable policies?

Forty or fifty years ago, it was generally assumed that the world was naturally divided between industrialized and agricultural societies, an arrangement in the best interests of all. After World War II, the term *developing countries* was coined, the new assumption being that all countries, although different at birth, were destined to become equally modern, industrialized, and rich. *Modernization* was the key concept, and it

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was to be transferred from central to peripheral countries through technical assistance programs, education of their elites in the values of Western civilization, and the enlightened presence of branches of multinational corporations in their territories. But Latin America would not wait for modernization to fulfill its promises. In the 1960s and 1970s, first industrialization and later technological self-reliance came to be viewed as the only ways to break the vicious circle of poverty, backwardness, and *dependencia*. This combination had been identified in the golden years of the United Nations' Economic Commission for Latin America with economies based on the export of primary goods. For a while, the strategy of government-induced industrialization and technological development seemed to work in some Latin American countries. The crisis of the eighties, however, rekindled the old arguments based on theories of comparative advantage and modernization through the free market.

According to the extreme form of these theories, there is really nothing that a developing country can do to join the club of advanced countries. It is held to be illusory to think that economic realities can be rigged by government policies. If a country is endowed with comparative advantages and allows market forces to follow their course, these forces will reveal the country's potentialities and put them to good use. If not, too bad.

Now in the 1980s, it has become fashionable again to think that modern technology and modern industries may be inadequate for less-developed or non-Western countries after all, being too expensive, too complex, too dangerous. These industries are said to offend the environment, concentrate income, lead to unrealistic competition with industrialized countries, and may even place dangerous weapons in the hands of irresponsible parties. The idea that countries that are different at birth should remain different is recovering ground on both sides of the equator. Should not the North be more respectful of the cultural and historical idiosyncrasies of the South and cease trying to feed Southern nations Western values and culture? Should not the South stop trying to ape the North and instead seek its authentic origins and vocations?

Empirical research has been used continuously to bolster or refute these sweeping, yet changing, generalizations. The books to be discussed in this review can all be read as intended to confirm or elaborate the thesis that technology and its corollary of advanced industrialization can place Latin America on the same footing with Europe and the United States. In a sense, these works belong to the transition period between the 1970s and 1980s and may either strengthen or undermine the current wave of pessimism. In actuality, none of the books under review discuss Latin America or underdeveloped countries as a

whole, only those countries that are now called new industrializing countries (NICs) or advanced developing countries (ADCs). In Latin America, this group seems to be limited to Brazil, Mexico, Argentina, and sometimes Venezuela and Chile. As for the rest, apparently all hope has already vanished.

North-South Technology Transfer: A Case Study in Petrochemicals in Latin America, by Mariluz Cortes and Peter Bocock, examines the issue of whether technology is actually transferred from North to South through market mechanisms. The introduction states, "As the technological capacity of developing countries has come to be seen as one key to their overall economic development, economists and policy makers alike have begun to ask questions about the technology transfer process and its consequences. In particular, interest has focused on the extent to which transfer mechanisms affect the ability of recipients to acquire indigenous technological capability and to operate their plants independently of suppliers" (p. vii). To examine this question, Cortes spent years amassing an impressive amount of data on one particular aspect, the transfer of petrochemical technology to a group of industrializing countries in Latin America. Her materials were subsequently organized by Bocock into this volume, which was published by the World Bank. Most of the work was carried on in the World Bank's department of economic development.

The main result is to show that the realities of technology transfer are much more complex than one would generally think. *Technology transfer* can mean very different things, from preinvestment, feasibility, and marketing studies to basic engineering, detailed engineering, procurement and construction, training of personnel, start-up, troubleshooting, and technical assistance; and it can deal with basic, intermediate, or final production processes. Technology can be "packaged" to different degrees, depending on who are the suppliers, who are the receivers, and what kind of technology is being discussed. Suppliers can be either process owners or producers. Process owners will usually transfer basic technology and processes, while producers tend to deal with final products and to participate in operations after start-up, that is, in the actual production and marketing of the final products. Recipients vary by size, ownership, and local technological capabilities.

No clear lesson emerges from *North-South Technology Transfer* except for a better grasp of the difficulties involved. For Cortes and Bocock, there are no "general policy prescriptions" to be derived nor stable economic processes to be comprehended because the standard theories of technology diffusion—the technology gap and product life-cycle theories—have only "limited application" to the case at hand. The authors conclude that "The world of technology transfer is not an economic determinist's morality play, in which all issues are clear-cut and

involve straightforward conflicts between the righteous and the self-serving" (p. 133).

The other side of the technology transfer issue is technology generation, and in this sense, the volume edited by Jorge Katz can be considered a complement to the Cortes and Bocock study. But Katz's *Technology Generation in Latin American Manufacturing Industries* actually deals more with questions of technical change and general technical progress than with "technological innovation" as such. This collective work originated from a series of papers presented at the Seminar on Technology and Economic Development in Buenos Aires in 1978. These papers resulted from the largest research program ever assembled on the topic in the region, with the support of the Inter-American Development Bank, the Economic Commission for Latin America, the United Nations Development Program, and the International Development Research Corporation of Canada. Part I of *Technology Generation* includes Katz's piece on domestic technology generation in less-developed countries, which summarizes the main conclusions of a series of case studies, as well as theoretical articles on the economic theory of innovation by Joseph Stiglitz, Richard Nelson, and Simón Teitel. Part II contains a series of case studies on technological change in companies and industries and two macroeconomic studies; Part III includes two "preliminary theory-building efforts" by Morris Teubal and Adolfo Canitrot.

Rather than attempting to evaluate the theoretical and conceptual achievements of this collective work, I will consider what Katz describes as the main findings of the first four years of the project. The first findings relate to the "rate and nature of the domestic technology-generating efforts carried out by different companies and manufacturing sectors," then "the macro and micro-variables which affect such knowledge-generating efforts," and finally "the consequences—upon such performance indicators as overall factor productivity growth, export capacity, etc.—of the local technological efforts" (p. 14).

There are no straightforward answers to the questions posed. The basic conclusion about the first item seems to be that technology generation by firms is a gradual learning process rather than the simple adoption of off-the-shelf technological packages according to rational economic choices. Cost-reduction is only one of the objectives of technology generation, others being product diversification, improved quality, and better use of installed capacity. The intensity and direction of this effort depends on the competitiveness of the environment, the relative cost of capital equipment, the expansion of demand, the rate of interest, tariffs, availability and cost of skilled personnel, tax incentives, and other factors. They also vary according to the kind of technology and industry under consideration. The final result can be very significant in terms of productivity growth, but often as a consequence of

“minor” technological changes and adaptations rather than of true innovation. Once a firm has engaged in the learning process, and if the external and institutional constraints are not too limiting, the firm can approach the international levels of productivity for its sector. According to Katz, “In our view it is exactly a situation of this sort on top of conventional explanations, such as relatively lower wage rates, that partially ‘explains’ the growing international competitiveness of a large number of enterprises from newly industrialized countries” (p. 46). Whether a given firm or sector will follow this path is difficult to predict. In the end, it is as impossible to generalize about technology generation as it is about technology transfer: “the answers firms come up with are likely to be specific and idiosyncratic rather than general and easily transferable” (p. 44). Katz’s conclusion expresses extremely guarded optimism: “[A] few decades behind the Japanese or Italian ‘catch-up,’ on a more reduced scale, and within the context of much greater market imperfections and structural weakness, specific industrial subsectors of the newly industrializing countries of Latin America are showing increasing signs of economic and technological maturity even within the midst of relatively backwards domestic development situations” (p. 47).

In spite of the contributors’ warnings, their conclusions can be summarized by saying that technical change in individual firms and sectors, if taken as a mix of “true” technological transfers and local innovations, can lead to significant results in certain cases. “True” technological transfer and innovation are not fully explained by external macro or micro economic variables. On the macro level, they depend on governmental policies, availability of local expertise and competence, market conditions, and the nature of the technology (its complexity, rate of expansion, and other variables). Whether firms at the micro level will be able to grasp the opportunities depends less on choice than on their ability to engage in a gradual learning process of technological innovation, which in turn depends on the firms’ size and varies according to which segment of the productive cycle is involved, from plant construction to production.

One can generalize further by saying that technological and industrial “catching up” depend on the existence of clear governmental policies. These policies must take into account the realities facing the bearers of new technologies, the overall constraints of the technologies involved, and the operation of market mechanisms. Two books under review here directly address policy questions.

Emanuel Adler presents a detailed comparison of high-technology policies in two major Latin American countries in *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil*. A political scientist rather than an economist, Adler attempts to explain

how “technology development has occurred in those cases where structural indicators would have shown only a small potential for it” (p. 5). The two “success stories” have been the nuclear program in Argentina and the computer industry in Brazil, and the two corresponding failures, the Brazilian nuclear program and the Argentine computer industry. Adler’s explanation is summarized in the title of his book: the power (or weakness) of ideology. What gave consistency and shape to the Argentine nuclear program and the Brazilian “informatics” policy was that these policies were put forward by well-identified and well-organized groups committed to nationalist ideals, an element lacking in the other two cases. These “pragmatic antidependency guerrillas” or “subversive elites,” as Adler calls them, were able to compensate in Argentina for the traditional “fracasomanía” and in Brazil for the established open-door policies regarding multinational corporations. Both Brazilian and Argentine “guerrillas” represented unholy alliances of academic intellectuals and the military. In Argentina, Jorge Sábato’s group allied with the Navy in the Consejo Nacional de Energía Atómica; in Brazil the physicists trained at the Instituto Tecnológico da Aeronáutica and the Universidade de Campinas joined first with the military in the Navy and later with the intelligence establishment, the Serviço Nacional de Informações, to create the Secretaria Especial de Informática. The intellectuals brought technical competence and quality to the alliance while the military contributed institutional stability and access to public funds. These components were lacking in both the Brazilian nuclear program and the Argentine computer industry, thus explaining for Adler their ultimate failure.

The main question regarding *The Power of Ideology* is whether Adler’s cases of success are actually successful. Argentina unquestionably beat Brazil in the race to produce nuclear energy and master the fuel cycle. The Brazilian nuclear program remains in shambles due to cost overruns and technological failures (including the turnkey Westinghouse power plant in Angra dos Reis), and Adler’s explanation of the differences makes sense. An issue that is less clear, and one not addressed in Adler’s book, is whether the Argentine nuclear program, which uses heavy water and natural uranium, provides a good basis for future development and an adequate answer to the country’s projected energy needs. Similarly, Brazil’s achievement in establishing a domestic microcomputer industry is impressive, even more so when contrasted with Argentina’s failure to do anything significant in this field. Less certain is the mid-range viability of the Brazilian “informatics” policy when compared with that of new industrializing countries in Asia. Adler never discusses relative costs or alternative strategies. He is steadfastly optimistic in his belief in the power of ideology, and in this sense,

his book is very much a product of the late 1960s and 1970s, rather than the 1980s.

If pessimism is a measure of modernity, then certainly the most modern work in the group is *The United States and Mexico: Face to Face with New Technology* by Cathryn Thorup and contributors. It is, from the outset, a policy-oriented work. Publication was sponsored by the U.S.–Mexico Project of the Overseas Development Council, which brings together individuals from universities, governments, and private sectors in both countries “in an ongoing process of policy research and dialogue to improve communications and policy making in the bilateral relationship” (p. xi). Editor Thorup, who directs the U.S.–Mexico project, has also conducted extensive research on the relationship between the two countries as a journalist. Most of the contributors are U.S. private-sector economists who are trying to analyze the broader context. Alan Madian discusses technology and the changing industrial balance, James Galbraith examines U.S. macroeconomic strategy, and Susan Sanderson analyzes automated manufacturing and assembly plants in Mexico. The collection also contains a significant contribution on Mexico’s new industrial development strategies by Mauricio de María y Campos, a high-ranking Mexican civil servant. Sectoral studies include those by James Womack on motor vehicles, Casio Fernández on biotechnology and food, and Joan Brodovsky on the pharmaceutical industry. Patricia Fernández Kelly provides an illuminating sociological study on employment patterns in the “maquila” companies along the U.S.–Mexican border.

The problem in Mexico, as in Brazil, is how to convert a policy of import substitution that was relatively successful in the past into an economic policy geared toward international efficiency and competitiveness for the future, and how to do so under the present conditions of a large external debt and an increasingly competitive and integrated international economy. The 1982 debt crisis exposed Mexico’s inability to keep on financing its growth through foreign loans and high oil prices. The crisis also led to a seemingly endless period of currency devaluation, increasing unemployment, and negative growth rates. Are the “maquiladoras,” the assembly plants that mushroomed along the U.S.–Mexican border in the last several years, part of the answer? Will technology continue to require only unskilled labor to handle it, allowing less-developed countries to create and expand their comparative advantage at the expense of the developed countries, as Madian suggests? Or, as Sanderson argues, is a tendency developing toward automation and the elimination of most unskilled labor in high-technology industries within ten to fifteen years? If so, will the maquiladoras, which employ mostly women for routine tasks, ever provide the basis for a

larger technological component in their products and in employee training and thus develop stronger backward links with the rest of the Mexican economy, as Patricia Fernández Kelly would wish? From the U.S. perspective, will its macroeconomic policies continue to allow for large imports from the advanced industrializing countries, as they did in the era of the strong dollar (which Galbraith expected to last much longer than it did), or will this tendency be reversed? Will the United States ever recognize the special kind of relationship that it ought to have with Mexico and assure its markets for Mexican products?

Prospects seem bleak in answering all these questions. Unless oil prices rise and remain high, Mexico will be forced to make painful economic adjustments. Will the country be able to plan fifteen to twenty years ahead, as Thorup suggests, despite the evident fragmentation in its policymaking process? Will the current debt situation be handled differently than it has been so far? In order to adjust, traditional industries would have to be dismantled, unemployment would likely rise, and control of the economy would pass increasingly to multinational corporations. As Galbraith predicts, "The rationality of even attempting to [adjust]—given the increasing misery of the people, the bleak prospects, the underlying trade surplus and the apparent high economic return to a simple default on the intermediate-term bank debt—will surely come under increasing question" (p. 98).

The situation in 1988 is already different in some respects. The prospect now exists for a long-term debt arrangement that was nonexistent only a few months ago, and the devaluation of the dollar will certainly help reduce the debt burden, even if it also reduces American imports. María y Campos's essay demonstrates that Mexican leaders are capable of understanding the problems and working toward solutions in a sophisticated manner. It is less clear whether they will have the time and circumstances to carry out the resulting policies, including political and social stability at home, conditions abroad that are not excessively hostile, and the pressure to proceed. If oil prices increase in the near future and the debt burden is lightened, Mexico may be able to postpone the costly adjustments now facing the country for a long time.

The volume edited by Francis Rushing and Carole Ganz is also "modern" in its skepticism about the efforts of several countries (including Brazil) to enter the world of high technology. *National Policies for Developing High Technology Industries* is another collection of papers, this one the product of a research project supported by the International Division of the National Science Foundation and the U.S. section of the Brazil–U.S. Business Council. The book includes an introduction by the editors, an introductory comparative article by Henry Nau, and eight country studies of national policies on high technology that cover Brazil, France, India, Japan, Korea, Mexico, Taiwan, and the United States.

This book makes an important contribution in helping expose the current myth that all efforts by governments and nationally protected firms to incorporate modern technology are doomed to failure and that only free enterprise and the presence of multinational corporations (as in South Asia) can succeed. As Nau observes in his introductory chapter, the question is not whether governments play a crucial role in the development of new technologies and modern industries (they do) but which kind of policies are successful and which are not. Two courses of action appear possible, one directed toward import substitution, the other based on a "domestic/export market approach." Both approaches require a large array of economic policy instruments, including monetary and regulatory policies, tax incentives, import controls, export incentives, and exchange-rate policies. The main difference is that the import-substitution approach tends to be voluntaristic and does not take economic realities into consideration, while the "domestic/export market approach" is based on much clearer assessments of internal and external market potentiality and comparative advantages of a given country.

For Nau, the issue "is not government versus markets, as it is often posed, but governments, as well as private groups, operating on market versus open-ended or arbitrary criteria for making technological and industrial decisions. Governments can influence but not deny market forces. In some cases, regardless of the effort they expend, they cannot convert any or every competitive (or absolute) advantage into a comparative one" (p. 14). The secret of recent successes in countries like South Korea and Taiwan involves a strategy of "forward integration." This strategy takes advantage of a highly competitive international market of high technologies by adopting high-technology processes in manufacturing, management, and marketing activities for all kinds of products and by undertaking large-scale production of components (like computer circuits or monitors), getting the final product at the end instead of at the beginning of the process. South Korea and Taiwan have also been helped by the quality of their labor force, which contrasts sharply with the low educational levels found in countries like India and Brazil.

Nau views the Asian countries as successful essentially because they have been able to play the game of international trade and comparative advantage, instead of looking for barriers and protection. His essay is illuminating on the first point but not particularly convincing on the second because protectionism has played a much larger role in these countries (and in Japan) than he is willing to admit. Nau is more concerned with the future realities of closed economies than with the achievements of protectionism to date. Protectionism may have worked in the past, but it will have more difficulty working in the future. Nau

asserts that newly industrialized countries "cannot make their case any longer, as they did in the 1970s, by arguing for a combination of discriminatory liberalization for their labor-intensive exports and broad-scale protectionism for their high-technology imports (e.g., the informatics sector in Brazil). This kind of export-skewed trade liberalization shrinks markets and hence growth. Technological nationalism, while still a potent political potion, is economic poison for the world economy" (pp. 27–28).

Nau would consequently view the Brazilian informatics policy, Adler's success story, as a big failure. Actually, it is as difficult to argue with Adler about that policy's early achievements as it is to argue with Nau and other recent analysts about its current predicaments. But the problem does not seem to be limited to the sins of protectionism. Adler's "subversive guerrillas" were powerful enough to create legislation protecting the Brazilian microcomputer industry, but they never had enough power to link it with broader industrial and economic policies or with a long-range program of scientific and technological research. Instead they created a stalemate that has intensified during the Sarney government and transformed the informatics policy from an aggressive project of technological self-reliance into a purely defensive screen for a group of stagnant and largely ineffective microcomputer assembly plants. This isolation, which reflected the segmentation of the state bureaucracy and the weakness of the federal government, probably prevented the Brazilian informatics policy from becoming more attuned to internal and external economic realities, which are now making themselves felt.

The ways that Brazil and Mexico are trying to cope with the new technologies and the new conditions of the international economy suggest strongly that ultimately (and despite their obvious significance) problems of external debt, exchange rates, and trade balances, or even changes in technology are secondary to the fundamental question of a country's ability to seize the changing technological and economic opportunities in the world. For instance, it is doubtful that the current devaluation of the dollar (in early 1988) will return South Korea and Taiwan to their status of fifteen or twenty years ago. The fates of Mexico and Brazil may differ, however.

It is difficult to say where this ability to recognize and seize technological and economic opportunities originates, but it is fairly clear that the source is neither sheer ideology (as in the example of the Brazilian computers) nor the opportunistic grasping of "market windows" (such as Mexico's *maquiladoras*). In the Brazilian case, high technology not only was sought despite economic logic but was often carried on fairly independently of significant policies for scientific research and

higher education. In Mexico the social isolation of the maquila industry is enough to show that its long-term impact will be negligible, even if its short-term financial contributions are significant. Part of the explanation for the Asian countries' success is that they started with a much more educated and homogeneous population, an asset that will become even more significant if mass production based on unskilled labor is replaced in the coming decades by automated industries and the consolidation of an economy based on services and flexible specialization in manufacturing.¹

Schools, universities, and technological institutes are the only places where a country can develop enough skilled labor, and university-based, academically oriented research is becoming the main source of competence to support long-term national policies of technological choice, adaptation, and (eventually) innovation. In countries like Brazil and Mexico, however, institutions of higher education are mostly too politicized and controlled by self-serving interest groups to be amenable to change and modernization on a comprehensive scale.² Consequently, scientists and technologists try, whenever they can, to organize their work away from universities or around well-insulated graduate programs. Meanwhile, economists' concern in recent years with "science and technology," combined with the power of their ideologies, has led to the progressive neglect of academic subjects in favor of supposedly more useful technological research. Such research is supposed to be carried on in the productive sector or in research institutes protected from the political and institutional hazards associated with institutions of higher learning.

In the end, high-technology industries remained (in the Latin American countries capable of establishing them) a series of more or less isolated enclaves. As such, they were protected from the rigors of international competition and the vagaries of local political crises, economic ups and downs, and distributive and clientelistic practices. This kind of "bureaucratic insulation" was probably necessary for the start-up phase, and Adler has documented how this goal can be achieved. The challenge of the 1990s will be to remove high-technology industries from isolation, root them more deeply in society, and make them economically meaningful. To do so, modern technology will have to be treated not merely as an ideology, an element of the production process, or a cultural and sociological reality, but as all three simultaneously.

The works written by Cortes and Bocock and edited by Katz, Rushing, and Brown offer good examples of what economists can and cannot achieve within the bounds of their discipline. They can break up the realities of "technology" into a myriad of components and perceive

(better than anyone else) how such components function within and between firms, then cross national boundaries, and appear or do not appear in government policies. One indication of the value of these economists' work is how quickly they reach the boundaries of their discipline and begin to talk about issues like the institutional learning processes involved in innovation, the political constraints on establishing viable economic and technological policies, or the broad educational and cultural context in which technological competence can grow. Here, however, their analyses usually end.

Traditionally, economists have talked about "science and technology" while thinking only about the latter, and their inability to incorporate "science" in their thinking has had important consequences in the science and technology policies they have helped create. Economists can talk about "policy," and better still, about economic policy, but they have difficulty understanding the political and institutional realities that condition the formulation and permanence of policy decisions. Economists have also discussed education and the role of a skilled population in economic development and technological modernization, yet their concern has not led to adequate proposals for educational reform and modernization. One could take these observations as a plea for interdisciplinarity, were it not for the fact that the other social sciences have generally lagged so far behind economics in their approach to these questions. Few political scientists equal Adler's efforts in *Power of Ideology* in attempting to move from the level of ideological imputations to analyzing specific political processes.³ The sociologies of science and higher education are new areas of inquiry in Latin America, and they face the difficult task of combining the micro and institutional levels of analysis, which are dominant in Europe and the United States, with broad questions like those raised here.⁴

Taken together, the books under review here demonstrate that technology alone is not as powerful as many analysts expected. No technological, economic, or policy "fixes" by themselves will succeed in endowing Latin America with the benefits of fully developed societies unless other conditions change as well. But this generalization should not be interpreted as confirming the prevailing pessimism of the 1980s. One can expect that in the 1990s, we will learn more about the ways that these and other policies of socioeconomic development can or cannot succeed. Then, with a little help from the social sciences, a renewed and more sober optimism can prevail.

NOTES

1. See Michael J. Piore and Charles F. Sabel, *The Second Industrial Divide* (New York: Basic Books, 1984).

2. See Daniel C. Levy, *University and Government in Mexico* (New York: Praeger, 1980); and Simon Schwartzman, "Brazil: Opportunity and Crisis in Higher Education," *Higher Education* 17 (1988): 99–119.
3. Another example is Peter B. Evans, "State, Capital, and the Transformation of Dependence: The Brazilian Computer Case," *World Development* 14, no. 7 (1986):791–808.
4. One of the few exceptions is the work developed under the leadership of Hebe Vessuri in Venezuela. See *La ciencia periférica: ciencia y sociedad en Venezuela*, edited by Elena Díaz, Yolanda Texera, and Hebe Vessuri (Caracas: Centro de Estudios del Desarrollo and Monte Avila Editores, 1983); and *Ciencia académica en la Venezuela moderna*, edited by Hebe Vessuri (Caracas: Fondo Editorial Acta Científica Venezolana, 1984). See also Simon Schwartzman, *Formação da Comunidade Científica no Brasil* (São Paulo and Rio de Janeiro: Companhia Editora Nacional and FINEP, 1979).