Minerva **36:** 229–251, 1998.

University-Industry-Government Relations on the Periphery: The University of Campinas, Brazil

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IN THE ADVANCED COUNTRIES industry–academic relations are now generally perceived as a "good thing", and the potential for expanding them is considered almost unlimited. Figures for different countries reveal that an increasing proportion of research in universities was funded by industry during the 1980s.[1] This, allegedly, was done through several novel forms of link between industry and universities, such as multi-party collaborations and strategic research alliances.[2] Reasons for the increase are said to include both an element of "demand-pull" by industry,[3] and "supply-push" in the university research system—the latter implying that universities must secure funding from non-governmental sources if they are to maintain or expand their research.

It has been suggested that these developments amount to a "second academic revolution", with significant implications for academic practices and norms, and also for a new social contract between academia and society. Large-scale government support for scientific research will only be sustained as long as research plays a key role in the new economy.[4] Government itself has nurtured the increased interaction between industry and university by creating schemes, measures and programmes to support it.

Science and technology policies designed in the advanced countries tend to be promptly adopted by developing countries,[5] and promoting and assessing university-industry collaboration is now a priority in the research agenda of all

[1] OECD, *University–Industry–Enterprise Relations in OECD Member Countries* (Paris: OECD, 1990).

[2] Webster, Andrew and Constable, J.P., "Strategic Research Alliances and 'Hybrid Coalitions'", *Industry and Higher Education*, IV (December 1990), pp. 225–230.

[3] It is claimed that technology-based industries, in an increasingly competitive environment, need to innovate continuously and to locate themselves close to major academic centres such as the universities. See, e.g., Pearce, R., *The Internationalisation of Research and Development by Multinational Enterprises* (London: Macmillan, 1989).

[4] Webster, Andrew and Etzkowitz, H., "Academic-Industry Relations: The Second Academic Revolution", a framework paper for the proposed research workshop on Academic–Industry Relations, London, Science Policy Support Group, 1991.

[5] See Ruivo, Beatriz, "'Phases' or 'Paradigms' of Science Policy?", *Science and Public Policy*, XXI (June 1994), pp. 157–164; and Sagasti, F., "Science and Technology Policy Research for Development: An Overview and Some Priorities from a Latin American Perspective", *Bulletin of Science, Technology and Society*, IX (1989), pp. 50–60.

countries. Brazil is no exception. National policy in the 1990s has stressed collaboration and has earmarked government funds specifically for research initiatives involving such partnership. Although the idea of linking universities to the needs of the productive sector is not new in Brazil, the mechanisms thought to foster the interaction and the "model" behind it have changed considerably over the last 30 years.

When the government institutions for science policy were first introduced in Brazil in the early 1950s, it was thought sufficient to foster science of good quality—this, sooner or later, would result in technological applications. This view was based on the then dominant linear model of innovation; it materialised in *ofertismo*, i.e., governmental action to create conditions in which universities could offer scientific results to industry which, in turn, would select and use them according to its needs. Moreover, it was believed that universities and public research institutes were themselves "responsible" for the transfer of knowledge to industry. Government policies stressed mechanisms for technology transfer—as if knowledge produced in public sector research was "ready" to be adopted by industry. The measures attempting to establish links between universities and the productive sector have been called the *vinculacionista* science policy framework.[6]

Ofertismo and *vinculacionismo* dominated science policy in Latin America, particularly in Brazil, until the second half of the 1970s when a new understanding of the relationship between science and technology and the process of technological innovation began to displace the linear model and the "ideology" of technology transfer. This new knowledge, generated in the advanced countries, prompted developments such as science parks, technology incubators, and compulsory partnership with industry as the criteria for receiving government research funds. Again, governments in less developed countries adopted these as "the way" to ensure useful research.

Relations between the university and the productive sector have been stimulated, directly or indirectly, by government plans and policies since the 1970s. The University of Campinas (UNICAMP) is a particularly apt example in this respect. First, it is a quite recent university, and was established at the beginning of the 1970s to differ from existing Brazilian universities. Traditionally, university scientists in Latin America had disliked the idea of doing academic research for commercial purposes; they had little understanding of industry or contact with it.[7] In contrast, UNICAMP was conceived as a research university which could anticipate the technological demands of industry. Second, it was set up at a time when government plans stressed the general objective of technological autonomy, and prospects favoured Brazil's

[6] On *ofertismo* and *vinculacionismo*, see Dagnino, Renato, Thomas, Hérnan Eduardo and Davyt, Amílcar, "El pensamiento en ciencia, tecnología y sociedad en Latinoamérica: una interpretación de su trayectoria", *Revista de Estudios Sociales de la Ciencia*, III (1996), pp. 13–49.

[7] Vessuri, Hebe M.C., "The Universities, Scientific Research and the National Interest in Latin America", *Minerva*, XXIV (Spring 1986), pp. 1–38.

potential as a significant participant in the international arena. Finally, UNICAMP was located in the most developed and industrialised region of the country.

Industrialisation by Import-substitution and the Role of Local Research and Development

Development processes in Latin America have typically been associated with industrialisation via import-substitution: internal production of the goods demanded by the middle and upper classes and formerly purchased from developed countries.[8] Given these countries' historical, cultural, social and economic features, there was a prior and rigid specification of the goods to be substituted, which considerably reduced the range of possible technological solutions.[9]

The relationship between import-substitution and technological dependence in the region became particularly evident after the Second World War. On the one hand, infant industries were struggling to establish themselves. On the other, big international corporations—which had the desired technological expertise—foresaw opportunities for profit in Latin American markets and low-priced inputs.[10] Technology transfer became the norm, not only for the transnational corporations (TNCs) which set foot in the region, but also for local firms.[11]

The experience of the so-called newly industrialised countries (NICs) made it clear that, to be fully successful, import-substitution requires additional public policies as well as the protection of infant industries. These must include income distribution measures and the systematic pursuit of social well-being. The example of South Korea illuminates the main faults in Latin America. In South Korea, social policies placed a limit on the import-substitution phase, which lasted only as long as the needs of the internal market were satisfied by local industry.

In contrast, in Latin America economic growth reinforced the concentration of income and transformed import-substitution into a "model" to be maintained indefinitely, as opposed to a limited phase. A pact among elites became institutionalised through public policies aimed at protecting the interests of dominant groups at the expense of the wider population. International

[8] Tavares, Maria da Conceição, *Da Substituição de Importações ao Capitalismo Financeiro: Ensaios sobre Economia Brasileira* (Rio de Janeiro: Zahar Editores, 1972).

[9] Morel, Regina, *Ciência e Estado, a política científica no Brasil* (São Paulo: T.A. Queiroz Editor, 1979).

[10] See, e.g., Wionczeck, Miguel, "El crecimiento latinoamericano y las estratégias de comercio internacional en la posguerra", in Diaz, Carlos *et al.*, *Politica Economica en Centro y Periferia* (Mexico: Fondo de Cultura Economica, 1976); and French-Davis, Ricardo, "La Inversión Extranjera en América Latina: Tendencias recientes y Perspectivas", in Urquidi, V. and Thorp R. (eds), *América Latina en la Economia Internacional* (Mexico: Fondo de Cultura Económica, 1976).

[11] Erber, Fabio, *Política científica e tecnológica no Brasil: uma revisão da literatura* (São Paulo: Saraiva, 1979).

changes forced the abandonment of this model before the "populist" promises made by the elites to include the majority as consumers were met. We consider this to be the main challenge facing present efforts to build an innovation policy in Latin America. To incorporate social considerations into the design of innovation policy, avoiding the trap into which the region's science and technology policies have fallen, could be the essence of an appropriate new approach.

Protectionism—a tool used by all governments when designing frameworks for industry and technology—exhibits idiocyncratic traits in Latin America. Considerable differences between internal and international prices were maintained through high import taxes, imposed indiscriminately and without a time-limit. This institutional framework reinforced the tendency to an acritical importation of technology and kept productivity low in most industrial sectors, without generating an innovative culture in the region. A well-known local economist referred to this situation as "frivolous protectionism",[12] inasmuch as its main objective was to ensure the industrial elites' privileges and further their own interests.

Despite being better known abroad because of the competitive threat they represented, it was not only the advanced technological sectors with a high and atypical share of national capital—such as the Brazilian aeronautical or informatics industries—which were the target of protectionist measures. Traditional and relatively stagnant sectors such as textiles, and dynamic technology dominated by international capital such as the automobile industry, were equally protected—to the detriment of Brazilian consumers' interests. In fact, it was not in the traditional sectors that the greatest productivity gaps *vis-à-vis* international best practices occurred; the gaps were in sectors where the administration of the technological gap by the TNCs allowed extraordinary profits to continue—within the social pact which became homogenous through their alliances with national capital.

As a consequence, Latin American firms remained uncompetitive instead of using their low-priced human and material resources and government subsidies to become innovative. TNCs also profited from these advantages, which in turn led to artificially high internal prices and allowed them to employ technologies far less efficient than those they had to use in more competitive markets.[13]

The character of the industrialisation model adopted, with its reliance on technology transfer, does not require local research and development but merely the capacity to operate technology developed elsewhere; local knowledge was only necessary in the agricultural and health sectors, for obvious reasons. Innovation has therefore been restricted to adapting

[12] The expression "proteccionismo frívolo" was coined by Fajnzylber, Fernando, in *La Industrializacion Trunca de América Latina* (Mexico: Editorial Nueva Imagem, 1983).

[13] Dagnino, Renato, "Cómo ven a América Latina los investigadores de politica cientifica europeos?", *Revista de Estudios Sociales de la Ciencia*, I, 1 (1994), pp. 73–112.

imported technology to specific features of local markets, workforce and raw materials.[14] Because this technology is supplied from abroad, local research and development is excluded or plays a strictly circumscribed role and cannot match the advantages of foreign technologies. With no demand from industry, scientific institutions lack the incentive to undertake productive activities or they are "marginalised".[15] Furthermore, this lack of pressure from the local economy means that the main determinants of research are the decisions of individual scientists, who take their lead from international trends.[16]

With this picture in mind, analysts of science and technology policy in Latin America have tried to break up this "circular–causal" process. First, by assuming the linear model of innovation, efforts were concentrated on improving scientific capabilities, the rationale being that high-quality researchers, well-equipped laboratories and strong institutions would produce "good science", which at some point would find application in technological development.[17] Latin American authors have called this an "*ofertista*" science and technology policy.[18] Government action in this framework includes the building of a scientific infrastructure, particularly through expanding graduate schools for training scientists in the 1960s and 1970s. Second, aware that science and industry were constantly working in parallel, official policy, and even some practical measures, have resulted in bridging mechanisms—the *vinculacionista* aspect of science and technology policies. This views the utilisation of knowledge by firms as an objective to be pursued by public sector institutions themselves; it was implemented through technology transfer offices, research foundations and other such divisions in most of the local universities.

Both *ofertismo* and *vinculacionismo* are important features of policies devised by government officials and policy-makers, segments of the scientific community who were eager to legitimate their social role, and entrepreneurs who—mistakenly—believed that public expenditure on science and technology could be a substitute for their own investment in in-house research and development.

The Brazilian case fits perfectly into these processes and their outcomes. However, it also has distinctive features, compared with other Latin American

[14] On this point see, e.g., Sabato, Jorge and Botana, Natalio, "La ciencia y la tecnologia en el desarrollo futuro de América Latina", in Sabato, Jorge (ed.), *El pensamento latinoamericano en la problemática ciencia-tecnologia-desarrollo-dependencia* (Buenos Aires: Paidos, 1975), pp. 143–154; and Katz, Jorge, *The Technology Generation in Latin American Manufacturing Industries* (London: Macmillan, 1973).

[15] Herrera, Amilcar, "Los determinantes sociales de la politica científica en América Latina", in Sabato, J. (ed.), *El pensamento latinoamericano, op. cit.*, pp. 98–122.

[16] Varsavsky, Oscar, *Ciencia, política y cientificismo* (Buenos Aires: Centro Editor de América Latina, 1969).

[17] Sagasti, Francisco, *Science and Technology for Development: A Review of Schools of Thought on Science, Technology, Development and Technical Change* (Ottawa: International Development Research Centre, 1980).

[18] Avalos, Ignacio, "La política tecnológica Venezolana: de la economia protegida a la economia abierta", *Espacios*, XII, 2 (1991); Sagasti, F., "Science and Technology Policy Research for Development", *op. cit.*

countries. Various initiatives encouraged national technological development. They should be seen in the political, economic and social context of the late 1960s and early 1970s: an authoritarian, centralised state resulting from the military coup of 1964; an abundant flow of international financial credit; easy access to mature technologies; exceptional growth of the economy; and an increasing demand for well-trained professionals. These elements produced an artificial "national consensus" that the country could play a significant part on the international stage, and gave rise to the "Brazil great power" project of the military.

To attain these goals, it was thought necessary to foster a distinctive phase of industrialisation via import-substitution, i.e., protectionism and market reserve mechanisms were to be applied to specifically selected sectors—all linked to military interests, such as aeronautics and informatics—while a long-term project for technological autonomy was in preparation. Government policies were designed accordingly: protective legislation for infant industries (market reserve); creation of research and development laboratories attached to state enterprises in strategic sectors; and reform of the higher education system.

Higher Education Reform in Brazil

The rationale behind the higher education reform followed two strands. First, if local research and development was to play a role in technological development, efforts had to concentrate—at least at first—on the public universities where the vast majority of researchers worked. Second, the universities had to be technically, politically and culturally adjusted to the new objectives, which included "the generation of technologies demanded by the accelerated modernisation".[19]

The university reform of 1968 was achieved through concerted political action involving the military and civil bureaucracies, the research community, and foreign organisations such as the United States Agency for International Development (USAID). As was to be expected, in content it differed considerably from the reform defended by the progressive forces which, before the military coup, had fought for changes in the structure of Brazilian society, including university reform. A university with social aims was envisaged, and the University of Brasilia was created on this model.

The model of a university with social aims was very much in the minds of the leftist intellectuals who thought the university had an essential role in making the country free, emancipated and just. The university, then, was to be "committed to the study and the search for the solutions to the problems which affect the majority of our population".[20]

This did not mean that the "social university" would ignore traditional standards of quality or restrict itself to services to the community. Much to the

[19] Romanelli, O., *História da Educação no Brasil: 1930–1973* (Petrópolis: Vozes, 1987).
[20] Goulart, João, *A missão da Universidade de Brasília* (Brasília: Editora da UnB, 1962).

contrary, the university was to demand quality for the products it generated; it was to maintain high standards, but university research was to be oriented towards solving social problems. Scientists would not be completely free to investigate whatever they wanted, but were to select research topics relevant to problems previously identified by government—preferably at the local level—or by other clients. The main audience for academic research would change, from other scientists to "external" clients.

This was the spirit in which the University of Brasilia was created. The first article in its charter established that the university's aim was to "to form citizens who will search for solutions to the problems of Brazilian people; and . . . to prepare highly qualified professionals and experts who are capable to promote social progress by using science and technology as resources".[21]

Given that the University of Brasilia was the model in the minds of influential members of the scientific community, it is not surprising that there was considerable reaction from some quarters of this community to the university reform imposed by the military. But it is worth remembering that 1968 inaugurated the worst period of the new regime in Brazil and that any opposition to government actions was severely punished. Moreover, important academic leaders left the country and, despite their protests from abroad, could do nothing to change things internally. It is also significant that the academic community had never before had such large funds for their research as in this period. A special government fund for research was created in 1969—the National Fund for Scientific and Technological Development (Fundo Nacional de Desenvolvimento Científico e Tecnológico, FNDCT)—which between 1970 and 1975 increased tenfold.[22]

The university reform included the establishment of graduate schools and full-time teaching and research faculty posts; new laboratories and libraries; and the creation of special research funds and government agencies. The Financing Agency for Studies and Projects (Financiadora de Estudos e Projetos, FINEP) is an example of a government agency, created in 1970, with the task of funding specific research areas deemed strategic for national goals. Other federal agencies, such as the national Research Council (Conselho Nacional de Desenvolvimiento Científico e Tecnológico, CNPq), created in 1951, had its activities redirected to meet government objectives. Changes included the first attempt to fund basic research according to government plans which were laid out in the Basic Plan for Scientific and Technological Development (Plano Básico de Desenvolvimento Científico e Tecnológico, PBDCT) of 1971.[23]

[21] Status approved by Law No. 1872, 12 December, 1962, as cited by Meneghel, Stela, "Zeferino Vaz e a UNICAMP: uma trajetória e um modelo de universidade", MSc dissertation, UNICAMP, 1994.

[22] For a detailed analysis of the role of FNDCT in promoting scientific research in Brazil, see Oliveira, Daniel A.R., "As Distorções da Trajetória do Financiamento à Pesquisa no País", *Revista Brasileira de Tecnologia*, XVI, 6 (1985), pp. 37–48.

[23] Cagnin, Maria Aparecida and Silva, Darly, *Ação de Fomento na História do CNPq* (Brasília: CNPq, 1987).

The creation of special research funds and agencies was a mechanism particularly designed to force the universities into the intended route: since university budgets were drastically cut by the government, researchers were stimulated to apply for government funds. Since the time of the reform which equipped universities to carry out research, this was done not from their own budgets but with extramural funds obtained from government research agencies. A comprehensive study of university research in Brazil carried out at the beginning of the 1980s indicated that university science depended heavily on external financial support, without which up to 90 per cent of the university research units analysed could do no research at all.[24] Such extramural funds, however, were not distributed among the various research fields according to uniform criteria, but were primarily directed at research in areas claimed to be strategic by the military in power. Evidence of this is the partition of research money from CNPq and FNDCT among the different fields: from 1970 to 1976, more than 75 per cent of such funds were allocated to exact sciences (physics, mathematics and chemistry) and engineering.[25] Physics "was still considered to be the main field of basic science in terms of contribution to [the country's] development".[26]

The term strategic—in a Brazilian context—did not refer to strictly military objectives or geopolitical assertion of the enforcement of the country's interests in the international arena, as in the case of the United States, for example. Security and development, which influenced the Brazilian military establishment, encompassed areas ranging from petroleum and electricity generation to telecommunications and informatics, as well as those traditionally linked to military interests such as nuclear energy and aeronautics. Thus, it was believed that university research could be directed via special research funds to cover fields deemed important to national technological needs.[27]

The outcome was a dramatic change in the quantity and quality of Brazilian research. Between 1969 and 1980 the number of graduate programmes (master's and doctoral) increased from 228 to 992, and the number of graduate students from 1,372 to 38,609.[28] In the same period, Brazil's contribution to international mainstream science more than doubled: it took

[24] Schwartzman, Simon, "For a Reappraisal of University Research", paper presented at the International Seminar on Development and Scientific and Technological Research Effectiveness, Rio de Janeiro, 15–18 January, 1985.

[25] Cagnin, M.A. and Silva, D., *Ação de Fomento, op. cit.*, p. 73.

[26] Kerr, Warwick, "Compromissos de Uma Comunidade Científica", *Ciência e Cultura*, XXI, 3 (1969), p. 617.

[27] Dagnino, Renato, "A Universidade e a Pesquisa Científica e Tecnológica", in Bori, Carolina (ed.), *Universidade Brasileira: organização e problemas* (São Paulo: Suplemento Ciência e Cultura SBPC, 1985), pp. 133–154.

[28] CNPq, "Pós-graduação: Previsoēs para 1985", *Revista Brasileira de Tecnologia*, XV, 6 (1984), pp. 62–67.

second place—after India—among the Third World countries, displacing Argentina.[29]

Research was heavily concentrated in institutions in São Paulo—particularly at the University of São Paulo and public research institutes in the agricultural and medical fields—and in Rio de Janeiro—mainly at the Federal University of Rio de Janiero (Universidade Federal de Rio de Janiero, UFRJ) and its powerful and productive unit for engineering research, Coordinação de Programas de Pós-graduação em Engenharia (COPPE), and at the Catholic University (Pontifíacia Universidade Católica, PUC). The scientific institutions located in São Paulo state and Rio de Janeiro were responsible for around 80 per cent of the country's scientific publications indexed by the *Science Citation Index* (SCI) in the 1970s. There were, however, considerable differences between the contributions of the two states: São Paulo produced over half of this output—the University of São Paulo alone contributed around 25 per cent of total scientific output—while Rio de Janeiro's share was 25 per cent: UFRJ produced around 9 per cent of Brazilian publications.[30]

Despite such concentration, research was no longer a spasmodic activity in the hands of a small elite with little stimuli beyond its own scientific curiosity. It became fully institutionalised in the whole country and its practitioners gained political and social influence. But the process met some resistance, particularly from segments of the student and faculty bodies who were sceptical of the "Brazil great power" project and disagreed with the political and socially unsympathetic measures imposed by the military.

The Technological Autonomy Project and the Creation of UNICAMP

The national conditions under which UNICAMP was created envisaged a particular role for the university, which not only influenced the choices concerning fields of science, specialties and qualification of researchers, but also shaped its relations with the productive sector. Because of the dramatic political and economic changes—both external and internal—during this period, the evolution of the relationships between the university and industry seemed to be in a "counter movement" to the trends observed in the advanced countries. In Brazil, we contend, such changes considerably diminished the university's role as a supplier of knowledge to industrial technology.

UNICAMP was created in the late 1960s, exactly when the national higher education system was in the process of reform. It was conceived of, designed and established in the light of what can be termed the Brazilian project for

[29] According to publication counts in the *Science Citation Index*. See Garfield, Eugene, "Third World Research", *Current Contents*, XXXIII (August 1983), pp. 5–15; and Arregui, Patricia, *Indicadores Comparativos de los Resultados de la Investigacion Científica en América Latina* (Lima: Grade, 1988).

[30] Morel, Regina and Morel, Carlos, "Um Estudo sobre a Produção Científica Brasileira, segundo os dados do Institute for Scientific Information", *Ciência da Informação*, VI, 2 (1977), pp. 99–109.

technological autonomy. UNICAMP may be considered a paradigmatic example of a Latin American university born of the "second academic revolution"—a new social contract between academia and society whereby "large scale government support for academic research will be sustained so long as the research plays a key role in the new economy".[31] In UNICAMP's case, the "revolution" took place within the university, through a privileged arrangement with the state apparatus, aimed at satisfying industry's demands.

The blueprint for UNICAMP maintained the already disputed idea of a university system organised in disciplinary departments and professional schools. Despite being an indefatigable defender of interdisciplinarity, its founder, Zeferino Vaz, encountered insurmountable resistance—from the scientific community, the funding agencies and the Ministry of Education—to the implantation of a university structure which would break with the traditional model. Vaz argued that he wanted "a university in which the arts and teachers of humanities integrate the epistemology centre, cooperate with the physicist, the mathematician, the chemist and the biologist, so that everyone will give up their narrow perspectives".[32] One of the most common arguments used against interdisciplinarity was that there was no existing model to follow anywhere in the world, and that, like it or not, knowledge is discipline oriented.

Nonetheless, UNICAMP was intended to inaugurate a new model for Brazilian research, with its basis in a research policy oriented to hard sciences and engineering, and guided by the demands of the productive sector.[33] The first courses at UNICAMP were in those exact sciences and engineering, "in order to meet the demands of local industry" and to acknowledge the interests of local entrepreneurs. The latter had been heard when the project was designed and had made a significant financial contribution to it. Courses in the social sciences started much later, in the mid-1970s—about ten years after the creation of UNICAMP—and those in arts subjects appeared only in the 1980s.[34]

The distinctive feature of UNICAMP's orientation to industrial demands was that instead of focusing on problem-solving and trouble-shooting, its research policy was designed to match potential future demands for new technologies, particularly those of the large state-owned enterprises in strategic sectors. This special type of arrangement with the state, in which research was projected towards future national demands in technological areas emerging internationally—such as fibre optics, lasers, new materials and sources of energy, telecommunications—made UNICAMP's experience unique among Brazilian and the Latin American universities.

[31] Webster, A. and Etzkowitz, H., "Academic-Industry Relations", *op. cit.*, p. 10.

[32] Franken, Tjerk and Guedes, Ricardo, "Entrevista do Prof. Zeferino Vaz a Fundação Getúlio Vargas", mimeograph, 19 December, 1977.

[33] Dagnino, Renato, "Condicionantes do Desempenho da UNICAMP em Pesquisa Científica e Tecnológica: Um Modelo a ser emulado?", *Cadernos do IG/UNICAMP*, I, 1 (December 1990), pp. 101–129.

[34] Meneghel, S., *Zeferino Vaz, op. cit.*

However, UNICAMP differed from the successful tradition in developed countries, where the determining factor was an internal movement within the university, led by the enterprise of individual professors and by the prospect of the market for new possibilities of technological application. In UNICAMP, the emphasis on strategic technology derived from the initiative of a prescient government and involved large research teams; in developed countries this emphasis could be attributed more to market stimulus, the capacity to absorb results, and the research developed by entrepreneurial scientists.

The successful implantation of this arrangement required that solid links be built between academics at UNICAMP and the civil servants dealing with science and technology and industrial policies. The ties between the founder of UNICAMP, Zeferino Vaz, who explicitly declared his support for the military establishment, also helped.[35] The relationship established with a more dynamic segment of national entrepreneurs was important in developing the new project. Although both these elements have been well analysed,[36] it is hard to know how far they were decisive. However, one factor can be evaluated: the profile of the first researchers employed by UNICAMP.

The latter were typically young scientists and engineers, trained in the leading Brazilian universities—the University of São Paulo and the Institute of Aerospace Technology; most of them had worked or done graduate studies in foreign institutions. This new brand of researchers, besides inaugurating innovative practices in the Brazilian university, shared the assumptions underlying both UNICAMP's goal and the national project for technological autonomy.[37]

Moreover, they brought a cosmopolitan perspective on local opportunities and the potential impacts of global trends. They had a clear perception of the research priorities needed to foster technological autonomy; a significant number, and certainly the research leaders, had worked in research laboratories with strong connections with industrial firms, such as Bell Laboratories. Such features made it possible to select lines of research that could—in the long run—maximise the economic impacts of academic activities. The choices made were often outside the international mainstream. For example, instead of trying to develop at UNICAMP the prestigious, expensive and "basic" field of particle physics, it was decided, in the early 1970s, to concentrate efforts in solid state physics—the scientific basis for the new information revolution.[38]

[35] Vaz, Zeferino, *Entrevistas CPDOC-FGV-RJ*, as cited by Fernades, Ana Maria, *A construção da Ciência no Brasil e a SBPC* (Brasília: Editora Universidade de Brasilia, 1990) p. 154.

[36] Meneghel, S., *Zeferino Vaz, op. cit.*

[37] These developments can be understood through the concept of "subversive elites" formulated by Adler, Emmanuel, *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil* (California: University of California Press, 1987).

[38] Dagnino, Renato (ed.), *O financiamento da pesquisa científica e tecnológica na universidade: o caso da UNICAMP* (Campinas: NPCT/UNICAMP, 1982); Brisolla, Sandra *et al.*, "El Instituto de Fisica de la UNICAMP y el desarrollo de la telefonia en Brasil: un caso de articulacion eficaz de intereses", in Vessuri, Hebe (ed.), *La Academia va al Mercado* (Caracas: Fondo Editorial Fintec, 1995).

Being linked to research fields outside the mainstream did not, however, prevent publication in the leading journals. Much to the contrary: Zeferino Vaz is well known for his high standards in terms of the scientific productivity of researchers. In 1974, only ten years after its creation, the contribution of UNICAMP to Brazilian scientific output, as measured by SCI counts, was 5.4 per cent.[39] This is not much less than the 8.7 per cent contributed by the Federal University of Rio de Janeiro, a much older university with 2,515 faculty members as compared to 714 at UNICAMP.

Government decisions on the technological autonomy project were soon implemented: research funds to Brazilian universities, which had grown steadily since the late 1960s, increased threefold between 1974 and 1979. UNICAMP was particularly successful in obtaining research contracts. For example, data on 1974 reveal that extramural research funds made up 25 per cent of its total budget; physics and engineering received together 85 per cent of its total research budget—evidence of the concentration of research funds in the few research fields deemed to be strategic; the Physics Institute received three dollars from external sources for each dollar of its internal budget.[40]

The investment of government research funds at UNICAMP and other universities of "excellence" was regarded as a step towards the next phase of the technological autonomy project. In this phase, the central role was to be played by state-owned companies operating in sectors where infrastructure required intensive technology, for example, telecommunications, oil production and power supply. As these companies matured, the capabilities developed at universities would be transferred to help them establish their own research and development departments.

The results were very positive for a while. The best example of this virtuous type of relationship was the role played by UNICAMP in the local development of technology for telecommunications. The process described seems to accord with the normative scheme known as "The Sabato Triangle".[41] Sabato's recommendation on the reinforcement of links between the three corners of the triangle—government, science and technology, and industry—was that the state should play a determining role in articulating and even in creating a national system of innovation: state corporations enjoy privileges which mean only they are capable of implementing the relationship between universities and industry in a peripheral environment.

The important role of state enterprises derived from recognition that private firms had neither the capital nor the human resources to carry out research and development. State enterprises would immediately pass on the technology they had developed to private enterprises as the only internal mediators at the same level as the TNC branches in the country. Just as

[39] Morel, R. and Morel, C., "Um Estudo sobre a Produção Científica Brasileira", *op. cit.*

[40] Dagnino, R. (ed.), *O financiamento da pesquisa científica, op. cit.*

[41] Sabato, J. and Botana, N., "La ciencia y la tecnologia en el desarrollo futuro de América Latina", *op. cit.*, pp. 143–154.

national private capital could not lead a national development project and state intervention was advocated, so it was in the technological sphere.

The importance of private enterprise as a proven agent of innovation was not belittled, but rather the role as substitute which a state enterprise could fulfil was overestimated. The state enterprise would be protected from competition, during the process, by private capital through protectionist measures.

The "Lost Decade" and the Abandonment of the Project

Technological spin-off of university research could only have been achieved if the second phase of the import-substitution model had been fully carried through. This second phase was to be based on the strengthening of technologically intensive sectors where TNC affiliates were not involved. However, things did not go as planned. The set of public policies were implemented in the hope of accelerating development, but not enough time was allowed for local capabilities to develop, and the scene was set for the indiscriminate importation of technology. There was a particularly strong cleavage between economic policies, which allowed the unrestricted entry of foreign capital—and science and technology policies, which aimed at developing local capabilities.[42] Since other public policies were not attuned to science and technology, the broader economic and social context remained little changed.

More specifically, the transnationalisation of the productive sector, fostered by the government's aim of rapid economic growth through foreign investment and technology inflow, considerably reduced the opportunities for utilising local research and development. Few industrial sectors—particularly those directly linked with military interests—were able to escape this perverse and paradoxical "logic". These sectors therefore turned towards a technological development strategy whereby disjointed "innovation systems"[43] introduced policies ranging from developing competence in science and technology, to the creation of a "business environment" favourable to the new local research and development capabilities. This happened, for example, in the aeronautics industry.

A correct appraisal of the Brazilian experience would minimise the university's "scanty sense of reality" or its "incapacity to develop technology that could be used by the productive sector", which are frequently claimed by bureaucrats working in the science and technology structure—first, because the role expected of university research has been inherently unrealistic. Indeed, the expectation that the university can serve as a storehouse of opportunities for innovation—and even contribute directly to its economic

[42] This has been termed implicit and explicit science and technology policy. See Herrera, A., "Los determinantes sociales", *op. cit.*

[43] Stefanuto, Giancarlo, "As empresas de base tecnológica de Campinas", MsC dissertation, UNICAMP, Campinas, 1992.

application—receives no backing, even in the most successful international experiences of interaction with the productive sector. In clearly adverse national circumstances, emulation of international experience, and the expectation that the university could stimulate a process of technological catching up, seem naïve hopes.

Second, even the meagre research results produced found no opportunities for utilisation. As the atypical successful cases show, where effective economic demands for locally developed technology existed, the university was ready to respond. This was the case, for example, in the development of fibre optics by the Physics Institute of UNICAMP which was supported not only by a government fund but also by private industry, indicating "economic demand".[44] In other words, when state initiatives, mediated by public enterprises, succeeded in breaking up "frivolous protectionism", universities were able to participate in technological development.

In addition, the anticipated economic growth—let alone social development—assumed by the technological autonomy project did not materialise. The rapid deterioration of the science and technology system in the 1970s was not, however, simply a result of the financial crisis in the public sector, and the consequent reduction in investments in fields with little political influence and only long-term prospects. Even if funds for planning and development had not been reduced, sooner or later the enthusiasms of the previous decade would have cooled. Besides, this aspect related to "supply-push", the fact that the great infrastructure projects—for which the whole research strategy had been conceived—were postponed and finally abandoned, increased the opportunity cost of investment in science and technology and made it no longer viable.

The 1980s, however, were more than a "lost decade" for UNICAMP. Despite its expansion, and notable changes in circumstances, the university maintained the research structure established in the 1970s. Decision-making within the university has seemed incapable of incorporating changes creatively and modifying the original project—at present unfeasible—to remain committed to the future technological demands of Brazilian society. The absence of explicit, rational and participative decision-making, which could have led to a new long-term project for UNICAMP, and an environment characterised by conservatism and by palliative adjustments, resulted in decision-making of an incremental type. Mutual adjustment between supporters of barely differentiated courses of action led to the satisfaction of often corporativist interests, to a mere reproduction of the past, and to the slow abandonment of the premises which had fuelled the innovative project. The policy-making process at UNICAMP has clearly been incremental rather than rational.[45]

[44] Brizolla, Sandra and Pinto, Luzia, "El Instituto de Fisica de la UNICAMP: la fibra optica y la telefonia en Brasil", *Quipu*, VIII (September–December 1991), p. 301.

[45] On incremental and rational styles of policy-making, see, e.g., Ham, Christopher and Hill, Michael, *The Policy Process in the Modern Capitalist State* (London: Harvester Wheatsheaf, 1993).

The relative weight of the different disciplines—evaluated by internal budget, and the number of students and professors—remained static. Apparent exceptions to the university *status quo* can also be explained by this incremental attitude and the influence of external stimuli: opportunities or pressures arising from governmental action. There is substantial evidence for this. For example:

—The expansion of the medical field: between 1985 and 1990, staff at the School of Medicine increased much more than the number of students. This was perhaps due to an initiative of the São Paulo state government, which tried to counteract the crisis in the public health system by expanding university hospitals. On each occasion, these became more involved with primary health services instead of concentrating on research and teaching.

—The expansion of the economics faculty: between 1984 and 1989, the number of faculty in the Institute of Economics increased twofold; this raised the teacher–student ratio of the institute to a level more than double that of the university's average. Financial resources were provided by the São Paulo state government specifically for this end.[46]

—The increase in building: between 1983 and 1989 the constructed area of UNICAMP more than doubled, thanks to international funds from special programmes for developing countries (such as the Interamerican Development Bank) earmarked for education.

—The facade of modernisation adopted in 1985 in five main areas of research: informatics, biotechnology, new materials, fine chemistry and precision mechanics—all stimulated by government promises of specific resources.

—The creation of an interdisciplinary research centre in biology, chemistry and agriculture: the closure of a Monsanto research laboratory in Campinas and its sale to UNICAMP, in 1986, for 3 million dollars (UNICAMP's total budget was 133 million dollars in 1985) triggered the establishment of the centre.[47]

—The creation of evening courses: after unsuccessful attempts by the university to meet the needs of lower-income students, evening courses were compulsorily created by the State Constitution of 1988. In Brazil in general, and at UNICAMP in particular, these are not continuing education courses as they are understood elsewhere: they are normal undergraduate courses, supposedly for those who work during the day. However, because UNICAMP is a public university, free of any charge, and a good university, the demand for places is very high. A significant proportion of those who pass the entrance examinations for evening courses are middle-class people who do not have

[46] These two events show how the absence of a collectively formulated policy can be exploited by group interests. Alliances between the two main forces within the faculty—the physicians, who have been able to nominate two of the four presidents of UNICAMP since 1980, and the increasingly influential economists, who nominated the most successful university president over the same period—have to be regarded as the primary cause of these outcomes.

[47] Mercado, Alexis, "La constitución del Centro de Investigaciones Quimícas, Biológicas y Agrícolas de la UNICAMP: el CPQBA", in Vessuri, H. (ed.), *La Academia va al Mercado, op. cit.*

jobs, and only apply because competition is lower than for day courses. Once accepted, they start to attend classes during the day, since the courses required for graduation are the same. Thus, evening courses, in the end, do not wholly fulfil their "social intention".

The policy-making style of UNICAMP in this period is unsurprising, given the difficulties faced by the science and technology system generally in responding to the changing environment through internal reorganisation.

The year 1983 may be considered a divide in the evolution of Brazilian science and technology policy, as the military saw their regime coming to an end.[48] The stagnation of policy reinforced disciplinary internal dynamics as well as the relative influence of research groups.[49] In these circumstances, the research community adopted a self-defensive strategy, dependent on the old social contract of the linear innovation model—which was even more inappropriate than before. This strategy was reflected in the abandonment of priority areas for funding, and pressures from the expanding scientific community for a more "democratic" allocation of funds among scientific fields based on "excellence" or "merit". The result was a rapid increase in the participation of the biological and social sciences in the CNPq budget and in FNDCT: in the 1980s there was an almost even distribution of funds among the main fields of science.[50]

In this general climate, UNICAMP adopted a non-decision-making position in its research policy.[51] In doing so, it ignored the dramatic changes in Brazil's institutional environment, which began in the 1980s and are even more marked today.

The Neo-Liberal Challenge and Beyond: The Need for a New Research Policy

From 1985 onwards, three civilian presidents took over the federal government. They consistently abandoned the model of industrialisation through import-substitution. Internally, the diagnosis giving rise to this reorientation was based on three factors: consumption by the high-income classes, which had stimulated the new local industries, was no longer capable of supporting reasonable rates of economic growth, even with the excessive levels of protection being practised; the growing financial and technological difficulties of substituting basic goods; and the maintenance of the concentration of income in the upper classes denied most of the population access to consumer goods which could have made profitable increases in production feasible. Externally, growing international pressures arising from globalisation, in the sense of opening up of Third World markets, have undeniable importance.

[48] Dagnino, Renato, "To the Barracks or Into the Labs? Military Programs and the Brazilian S&T Policy", *Science and Public Policy*, XX, 6 (December 1993), pp. 389–395.

[49] Biato, Francisco *et al., Projeto Estudos Analíticos do Setor de C&T no Brasil* (Brasília: Ministério de Ciência e Tecnoligia, 1993).

[50] Cagnin, M. A. and Silva, D., *Ação de Fomento na História do CNPq, op. cit.*

[51] On the concept of non decision-making see, e.g., Hogwood, Brian and Gunn, Lewis, *Policy Analysis for the Real World* (Oxford: Oxford University Press, 1985).

The new model is based on the attraction of external capital and technology and on the exploitation of developed countries' market niches.[52] Industrial and technology policies are being revised to include: incentives to import technology and foreign capital in the few technology-intensive sectors (traditionally under state control); less protectionism of infant industries; the reduction of import duties; and changes in intellectual property legislation. All this points to a passive adaptation to a new global order, a capitulation to long-standing demands of the international power centres such as multinational firms and the leading industrial countries. Consequently, giving up a strategy aimed at achieving technological autonomy is endangered. On their side, the leading industrial countries are setting up the conditions for the expansion of TNCs and for promoting their own technologies.

In such a context, it is not surprising that Brazilian science and technology policy has become increasingly disoriented. With the abandonment of the technological autonomy project and the import–substitution model, the role expected from university research has significantly changed. A new arrangement in relations between Brazilian universities and the productive sector is now under way: the university will be responsible for adapting imported technologies, for routine and troubleshooting activities, and for some consultancy work. These indeed characterise the links between universities and the productive sector in Brazil today, UNICAMP included, as recent studies indicate.[53] Although such studies rarely present hard data on this partnership, they present the researchers' perception of the process. Scientists are very aware of how things have changed and express themselves in variations of the following: "The university needs to rediscover its capacity to design and implement ambitious research projects in which interdisciplinary and large research teams produce important and relevant results, as in the past."[54]

The preliminary results of systematic and exhaustive data-gathering, covering the external contracts made by UNICAMP with state and private enterprises, public entities, etc., already confirm the results of partial analyses and case studies. Indicators such as the dimension of the project (judged by the value, duration, size of research team), type of activity (research, services rendered, etc.) show that the previous pattern, characterised by large projects contracted by state enterprises and involving lengthy research and long-term applicability, is being replaced by enterprises interested in quick solutions to their production bottlenecks.[55] The multiplying effect of the former pattern is

[52] Dagnino, R., "Como ven a America Latina los investigadores de politica cientifica europeos?", *op. cit.*, pp. 73–112.

[53] Velho, Silvia, "Relação universidade-setor produtivo: mitos e realidade", doctoral thesis, University of Brasilia, 1993; Gomes, Erasmo, "A Experiência Brasileira de Polos Tecnológicos: uma abordagem político-institucional", MSc dissertation, UNICAMP, Campinas, 1995.

[54] Galembeck, Fernando, interview, in Meneghel, S., "Zeferino Vaz", *op. cit.*, p. 167.

[55] Preliminary results of research under development at UNICAMP have been presented by Brisolla, Sandra and Gomes, Erasmo, "Relevancia Social de la Ciencia en los Paises en Desarollo", paper presented at the 2nd Jornadas LatinoAmericanas de Estudios Sociales de la Ciencia y la Tecnologia, Caracas, Venezuela, 9–11 September, 1996.

the significantly higher production of knowledge—whether in academic terms, or in institutional terms, i.e., the setting up of research teams with a certain stability and duration, linked with interdisciplinary work, quantity of resources involved, etc.

We hold that this is not the only possible—and certainly not the most desirable—role for university research in Brazil. The rationale behind the neo-liberal industrial and economic policies does not allow much room for local participation in the development of industrial technology. The only way for the university to do challenging research work, and at the same time produce socially relevant results, is by addressing "social problems". Private industrialists should not be seen as the only significant partners. The Brazilian state has an important role to play in the integration of at least half the population, who are so far excluded as consumers.

The need to use science and technology in the solution of social problems has recently been stressed at both ends of the policy continuum: the decision-makers and "users". The former have argued in government plans and studies that:

> A most serious problem facing the development of Brazil is the low level of literacy, numeracy and sciency [*sic*]. The improvement of this situation must be a priority of PADCT III,[56] of all the involved agencies, and of the President's Council for Science and Technology, with full participation of the Brazilian scientific community. There are basic societal problems (as in area of public health, education, sanitation, nutrition and sustainable exploitation of natural resources) where local research is needed as the key to solving the problems and improving the quality of life.[57]

Similar statements can be found in the *Plano Plurianual para Ciênca e Tecnologia* (Pluriannual Plan for Science and Technology) issued in 1995 by the Ministry of Science and Technology.

Among the "users", members of the scientific community—including a group at UNICAMP—have insisted on the urgency of discussing and designing a research policy for the university; the faculty association, for example, has been trying to encourage this by promoting seminars and workshops.[58] The origins of the debate lie in the frustration of academics who are increasingly aware of underutilisation of their research, and who are not satisfied by the argument that it serves to advance knowledge and is, therefore, justified. In political terms, a change in the present policy is proposed.

The debate arises from two extreme positions concerning two dilemmas: "academic quality" versus social relevance, and interdisciplinarity versus reinforcement of disciplinary segmentation. Contrary to what many believe, a focus on socially relevant research does not inevitably lead to routine, unchallenging research which renders no internationally publishable papers.

[56] PADCT III is a science and technology programme sponsored by the World Bank and the Brazilian government.

[57] PADCT, "Report of the GEA Meeting", Brasilia, January 1995, p. 69.

[58] ADUNICAMP, *Cadernos da ADUNICAMP*, IV (1991); *ibid.*, VIII (1995).

On the contrary, socially relevant research implies a mapping of the problems to be solved, and of the science and technology component of those problems; the development of new theories and methods, equipment, databases and information services; the adoption of a multidisciplinary perspective and, consequently, the introduction of innovative research practices; and the incorporation of representatives of existing but excluded social groups in setting research priorities. In this scheme, priority-setting would no longer focus on fields of knowledge in the belief that the results would have a greater chance of being used. Priorities would have particular social problems as their targets, and these problems would be identified from several perspectives. Having identified problems, the next step should include evaluation of the science and technology needed, so as to involve scientists from different fields who would work together on solutions.

São Paulo, the most important Brazilian state for sugar cane, sugar and alcohol production, can illustrate the "model". Much has been done at local universities to solve production problems—both agricultural and industrial. It is well known that the social conditions in sugar cane production are unjust, and its practices very environmentally damaging: research at local public sector institutes has focused on these two fronts. All investigations into the various dimensions of the problems—by different institutes of UNICAMP, for example—are disjointed and uncoordinated. We propose that all with an interest in the topic of sugar and alcohol production—which, according to our model, would be the "social problem"—should meet in a forum promoted by the university (UNICAMP, for example) to discuss every aspect of the subject. Thus, sugar cane producers, labourers' representatives, environmental agencies, equipment producers, scientists, etc., would identify the problems and decide which need research or professional expertise to be solved. The university would then plan its activities, in a coordinated way, in order to meet the needs identified.

Of course this is an oversimplification of the process. Depending on social circumstances, problems and solutions will differ. However, we believe it would be possible to have the different parties meet, discuss and agree, after negotiation, on important topics which would help to confirm university research agendas. Such a process would be much more stimulating and challenging than simply responding to the demands of industry which may be further from a socially-just development project. Moreover, accepting social problems as a factor in setting priorities and choosing problems for research are ethical decisions. As such, they are easier to defend than the Sisyphean task of the Latin American scientific community in its quest for a place in the mainstream of international science.[59]

[59] Dagnino, Renato and Davyt, Amílcar, "Siete Equívocos sobre la Orientación de la Investigación Universitária", in Albornoz, M., Kreimer, P. and Glavich, E., *Ciencia y Sociedad en America Latina* (Buenos Aires: Editorial de la Universidade Nacional de Quilmes, 1996), pp. 232–249.

To start this process, Brazilian universities in general, and UNICAMP in particular, have to discuss research policy in the light of socially desirable objectives, compatible with the declared interest of the great majority of the university community. All this effort, even if made, may be insufficient if government agencies continue to allocate research funds on the basis of the traditional disciplinary criteria of "scientific excellence".

Conclusions

Far from facing the implications of this debate, current research policy at UNICAMP seems at a crossroads between discourse and practice. It is the result of two opposing forces. According to the first, UNICAMP has to engage in partnerships with industry and direct its research towards economic needs; this is seen as a progressive change inasmuch as it entails the university's increasing commitment to society. Accordingly, new mechanisms—ranging from science parks to technology transfer offices—have been devised and implemented by university officials since the beginning of the 1990s. Although these mechanisms' role in strengthening national technological capabilities is often mentioned, there is no evidence that they have been successful.

In practice, all rewards for scientific research at UNICAMP—promotion, allocation of research grants, prizes—put a premium on academic quality and disregard work which has not resulted in publication, citation, patent, and process or product development. Since the last three are very rare indeed at UNICAMP,[60] publications and citations are "the" measure of academic excellence.[61] In these circumstances, and in the absence of challenging scientific and technological demands from the productive sector, UNICAMP's research policy tends to be increasingly guided by "academic quality". This, at least, is the position of university officials. The ever-increasing competition between universities for government research funds which, again, are allocated on the basis of academic excellence, reinforce this tendency.

The picture is one of confrontation between the two criteria shaping UNICAMP's research agenda: demands from the productive sector and academic quality. Of course, in theory, these need not be contradictory, but they become so in the light of the current—and former—path of development.

The way out of this conflict is through what we believe is our main contribution to the current discussion on the relations between university, industry and government. We propose two additional criteria for setting up a framework for UNICAMP's research policy: multidisciplinarity and social relevance from a prospective viewpoint. In relation to the first, in contrast to the ever-present tendency to the segmentation and compartmentalisation of knowledge, interdisciplinarity is gaining importance in international scientific

[60] They are not the norm for university research output anywhere, and in peripheral countries are even rarer for structural reasons.

[61] Brito, Carlos, "Política de Pesquisa: A qualidade em primeiro lugar", *Cadernos da ADUNICAMP*, VIII (1995).

circles. This is not just a new academic challenge, but a demand arising from the nature of the increasingly complex and interacting problems of the real world. It is also a way of redirecting the faculty, which has become inert in face of the dilemma of educating professionals for a market which reproduces a past that most Brazilians wish to change, or preparing for a future which is a distorted reflection of the so-called advanced societies, but which we know to be "without a future".

The post-Second World War social contract diffused the concept, in university circles, that scientific activity is self-justifying; that the scientist's sole responsibility is to work effectively—while the state's role is to encourage this. This social contract is being questioned all over the world; external pressures on universities are growing as are the initiatives within them, which seek to increase the social relevance of research and attenuate the influence of the internal logic of disciplines. An increase in socially relevant research, in a manner compatible with inherent levels of quality, presumes initiatives on the part of the university: the establishment of a policy based on inter-disciplinarity, to allow for satisfactory treatment of issues relevant to society; and, based on desirable socio-economic goals, the establishment of global objectives of scientific and technological research.

The outcome desired by and for the majority of the population involves the solution of urgent social problems in areas such as employment, health, education and housing. This solution depends on important political changes in society as a whole.

In a more general vein, it is interesting to look at UNICAMP in light of some of the world-wide trends in university–industry–government relations. Concerning the assumption that "a new social contract is being drawn up between the university and the larger society, in which public funding for the university is made contingent upon a more direct contribution to the economy",[62] our analysis of UNICAMP indicates that this is not the case. On the contrary, although established in the 1960s and early 1970s according to the above directive, as time went by and the government's technological autonomy project was abandoned, links between UNICAMP and industry weakened considerably; they increasingly resemble those made before the "second academic revolution", i.e., consultancy work and small-scale problem-solving projects. In other words, there is a "downgrading" of the university's role in providing the scientific knowledge involved in the relationship. UNICAMP was created with the mission to anticipate the technological needs of strategic national enterprises. It was to contribute new knowledge and even initiate new technological trajectories. Nothing of this kind is expected today—the productive sector seems happy to use local universities to solve small problems of the technologies purchased from abroad.

The explanation may lie in the decline of the import-substitution policies in Latin America within a context marked by neo-liberal ideas. Such a model

[62] Webster, A. and Etzkowitz, H., "Academic-Industry Relations: The Second Academic Revolution", *op. cit.*, p. 10.

does not stimulate local research and development. However, as it evolved in Brazil in its more "sophisticated" phase—a stage in the technological autonomy project—it entailed a role for the local universities. With the abandonment of this model and the engagement of the country's elites in neoliberalism, even less is asked of the universities than under the import-substitution model.

In these circumstances, we believe, no mechanisms or policies fostered by either government or universities can succeed in linking university research to industry's needs. On the one hand, even more than before, local industry does not require local technology. With globalisation, industrial productivity and quality standards are decided by international parameters, so local industry has even more incentive to buy foreign technology. On the other hand, national firms seem unlikely to create their own research and development departments—a necessary condition for successful partnerships with universities.

It therefore seems desirable that UNICAMP undergoes a "third academic revolution", involving a new social contract between the university and the larger society in which public funding is made contingent upon a more direct contribution to the solution of basic social problems.

A last cautionary remark: our position is not dominant among the Brazilian community of science and technology analysts. For most of them, as well as for government officials, the new context is conducive to strengthening links between the academic and productive sectors. Moreover, to a considerable proportion of such analysts, this is desirable; the partnership between university and industry is regarded as beneficial to both sides. Not surprisingly, these analysts tend to belong to fields of knowledge more likely to be in demand by industry, such as engineering. In fact, a recent study at the University of São Paulo Polytechnic School has shown that the vast majority of scientists were very positive about interaction with industry. They even suggested that the assessment of their performance at the university should take less account of their publication records and more of their ability to obtain funds from industry.[63]

Sharing this view are many of the professionals and researchers in economics and business administration, who believe that problems and poor performance in university–industry relations are, in great part, derived from bad management. Consequently, they propose the design and implementation of appropriate and "correct" policy frameworks.[64]

Objections to what is seen as excessive emphasis on university–industry interaction in government policies come, typically, from two quarters. The first

[63] Mello, Debora and Velho, Lea, "As relações Universidade e Sociedade: um Novo Contrato Social?", paper presented at 2nd Jornadas LatinoAmericanas de Estudios Sociales, *op. cit.*

[64] Plonsky, Ary, "Cooperação empresa-universidade: antigos dilemas, novos desafios", *Revista USP*, XXV (1995), pp. 32–41; Medeiros, J. "Polos Avançados e Competitividade", *Estudos Avancados, Série Política Científica e Tecnológica*, XII (1993).

is composed mainly of very productive "basic" scientists who see such policies as an intervention in their choice of research problems and partners. They want to maintain their political influence in the research funding agencies, and are afraid that this new form of *vinculacionismo* will end up loosening the criteria for evaluating scientific excellence.

Other opponents, or reluctant supporters, are those who are sceptical of neo-liberal policies and strongly believe that the productive sector is not the only segment of society which should be served by the university. These researchers tend to be social scientists and they envisage for the university a larger role in the solution of social problems rather than production problems. This is where we tend to position ourselves.