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The New Social Contract Between Governments, Universities and Society: Has the Old One Failed?

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THE IDEA that a "new social contract should be drawn up between the university and the larger society" has spread widely.[1] It is mostly diffused as a moral sermon by public authorities, under the presumed pressure of society, to the prodigal, childlike scientific community which cares little about the social utility of its too expensive, playful activity. Over the 1980s and into the 1990s, the formula has produced its effects. The scope and value of state-funded programmes to support academic research have been reduced, and researchers have been "encouraged" to develop closer ties with industry. Despite criticisms by economists who raised objections to the application of a simplified linear or pipeline view of the relationship of research and development funding to innovation, and despite a slackening of research and development efforts by business enterprises themselves, public authorities continue to press for greater collaboration between research and industry and to employ a utilitarian discourse to justify further cutbacks in "non-utilitarian" research.

In contrast to those who advocate a new social contract between universities and industry, and to complement the critical literature on innovation, I question the nature of the earlier so-called "social contract": universities were not the major recipients of public research and development funding, particularly in Europe. By targeting universities under the "new social contract", the misidentification of private economic interests with the broader interests of society is strengthened, and the transparency of transfers from the public sector to private industry reduced. Discussion of the need for a "new social contract between the university and the larger society" must be based on a more thorough analysis, which considers the institutional specificities of differing national context. I look mainly at France, but in a comparative context that includes the United Kingdom, Germany and the United States.

Negotiated Social Contract or Political Fiat?

Two respected social scientists, David H. Guston and Kenneth Keniston, recently voiced their belief in the need for a new social contract between

[1] This has given rise to numerous conferences, including The Triple Helix of University-Industry-Government Relations, Amsterdam, 4–6 January, 1996.

universities and industry. Expressed in the broader terms of C.P. Snow's "two cultures", they argued that:

> [T]he changed world of modern science and modern government means that it is imperative to search for and begin to define a new contract, or series of contracts, between the institutions of democracy and the institutions of science. The scientific community needs to reach out to justify its claim on public resources by demonstrating where and how it is relevant in solving public problems. Science needs to earn the confidence of the public and the government, and to enhance its contribution to the general welfare.[2]

This statement gives rise to three main questions. First, what was the old social contract? Second, what are the arguments supporting the claims for an erosion of the old and thus the need for a new social contract? Third, who is making these claims?

For the participants in this debate, the "old social contract" can be summarised as an exchange in which "[G]overnment promises to fund the basic science that peer reviewers find most worthy of support, and scientists promise that the research will be performed well and honestly and will provide a steady stream of discoveries that can be translated into new products, medicines, or weapons". Based on this contract for almost five decades, the American system has been the most successful in the world, "whether measured in terms of people, products, patents, publications, or prizes", but in the late 1980s and early 1990s "the pattern of partnership and harmony between federal government and science has eroded".[3]

Why might this have occurred? Is it because scientists have ceased to perform their research task well? Has there been a decline in the number of discoveries which could be translated into new products, medicines or weapons? Neither answer is quite true. On the contrary, the performance record of the scientific community in the United States shows that it continues to win the lion's share of Nobel prizes—in chemistry, physics and medicine/physiology. The United States also produces the largest number of publications (although the indicators have important limitations and must be treated cautiously, the magnitudes are eloquent[4]), and they are the most frequently cited. The citation impact of journal articles in engineering, technology and applied sciences by American scientists is particularly dominant.[5]

The United States has remained the leader in terms of patent applications: in American patents its world share is 45.6 per cent and in European patents 24.7 per cent.[6] The translation of research results to new products, medicines

[2] Guston, David and Keniston, Kenneth, *The Fragile Contract: University Science and Federal Government* (Cambridge, Mass. and London: MIT Press, 1994), p. 32.

[3] *Ibid.*, p. 2.

[4] See Garfield, Eugene and Welljams-Dorof, Alfred, "Citation Data: Their Use as Quantitative Indicators for Science and Technology Evaluation and Policy-making", *Science and Public Policy*, XIX, 5 (October 1992), pp. 321–327.

[5] See *World Report on Science 1993* (Paris: Unesco, 1994).

[6] *Ibid.*, p. 143.

or weapons is obviously a much more complicated process, and it is the recognition of this fact which is missing in the arguments. As literature on the economics of innovation has shown, the relationship between research and development and the market is not a simple linear one. Rather, "science and research in all forms is only one necessary condition among a variety of sufficient conditions that initiate and drive innovative process".[7] While "academic research often provides new theoretical and empirical findings and new types of instrumentation that are essential for the development of a new product, . . . [it] does not provide the specific invention itself".[8] Moreover, applying the results of basic research requires research and development skills within the firm concerned.[9]

Some critics have also argued that fixing practical objectives for basic research might be more harmful than helpful to industry itself—for example, if it leads to forgoing important indirect advantages to industry, which may result from unprogrammed fundamental research conducted out of pure curiosity.[10] Finally, as Keith Pavitt argues, a case can be made for the "usefulness of science" in terms of the diversity and complexity of the impact of science on technology.[11]

Despite reservations about the direct link between basic research and innovation, it is nevertheless evident that many industrial innovations had their origins in scientific discoveries and basic research carried out in universities. This is particularly true in the pharmaceutical industry and in biotechnology, but it applies to other sectors as well. Mansfield's study of the contribution of academic research to industrial innovation, based on a random sample of 76 major American firms in seven manufacturing industries (information processing, electrical equipment, chemicals, instruments, drugs, metals and oil) reports noticeable differences between these sectors. Yet, the fact that in the case of drugs, information processing, instruments and metals, academic research has contributed to a higher percentage of innovations "with respect to new products can be explained by differences among firms in research and development intensity. . . . Holding research and development intensity constant, interindustry differences are not statistically significant".[12]

[7] Kline, Stephen, "Innovation is Not a Linear Process", *Research Management*, XXVIII (July–August 1985), p. 44.

[8] Mansfield, Edwin, "Academic Research and Industrial Innovation", *Research Policy*, XX, 1 (1991), p. 3.

[9] Rosenberg, Nathan, "Why do Firms do Basic Research (with Their Own Money)?", *Research Policy*, XIX, 2 (1990), pp. 165–174.

[10] Nelson, Richard R., "The Simple Economics of Basic Scientific Research", reprinted from *Journal of Political Economy* (June 1959), in Rosenberg, Nathan, *The Economics of Technological Change* (Harmondsworth: Penguin Books, 1971), pp. 148–163.

[11] Pavitt, Keith, "What Do We know about the Usefulness of Science? The Case for Diversity", in Hague, Douglas (ed.), *The Management of Science*, Proceedings of Section F (Economics) of the British Association for the Advancement of Science (Sheffield: Macmillan, 1989), pp. 30–31. On specific points, see *ibid.*, pp. 21–46. See also Pavitt, Keith, "What Makes Basic Research Economically Useful?", *Research Policy*, XX (1991).

[12] Mansfield, E., "Academic Research and Industrial Innovation", *op.cit.*, pp. 2–3.

Citation analysis of references in United States patent applications, such as that undertaken by Narin and Olivastro, shows a steady increase in references to the scientific literature in almost every product field; among the five countries covered by the study—the United States, Japan, the United Kingdom, the Federal Republic of Germany and France the United States "has the largest number and the more rapid rate of increase".[13]

The growth of Japanese competitiveness itself has been largely based on American scientific discoveries and inventions.[14] The continued technological supremacy of American weaponry, largely based on scientific research, also suggests that the old order is still producing the expected outputs. As a result, to accept Guston and Keniston's contention that "science needs to earn the confidence of the public and the government, and to enhance its contribution to the general welfare", must imply a loss of confidence in science for other reasons.

It is not difficult to recognise some of the more striking problems in current scientific activity. These include irresponsibility with regard to some genetic research; research which on political or moral grounds has long been criticised, such as work on the atomic bomb or chemical warfare; large very costly projects such as the supercollider; and research that is not directly user-oriented, such as the genome project. However, these are not the main reasons given to justify the need to "rethink the contract between science and society".[15] Instead, the debate seems more often to turn on arguments such as "alleged scientific fraud" which reflect a "loss of public confidence in the capacity of academic science to regulate itself";[16] "claims that federal funds had been spent by research institutions for liquor, yachts and (the supreme irony) even on lawyers to defend themselves against federal lawsuits";[17] "the openness of American universities to foreign researchers and students [which] allows . . . economic competitors [of the United States] to steal scientific and technical secrets whose development has been funded by United States tax payers for the express purpose of competing in the international marketplace";[18] or, "collaborative relations with foreign-affiliated corporations";[19] "greediness and selfishness" of scientists "in their unending quest for new

[13] Narin, Francis and Olivastro, Dominic, "Status Report: Linkages between Technology and Science", *Research Policy*, XXI (1992), p. 243.

[14] It has also required from Japanese firms "high levels of indigenous research and development activities . . . , investment, capacity of learning and improving". Pavitt, Keith, "Internationalisation of Technological Innovation", *Science and Public Policy*, XIX (April 1992), p. 120.

[15] Guston, D. and Keniston, K., *The Fragile Contract*, *op. cit.*; Brooks, Harvey, "Research Universities and the Social Contract for Science", in Branscomb, L.M. (ed.), *Empowering Technology: Implementing a US Strategy* (Cambridge, Mass.: MIT Press, 1993), pp. 202–234; Etzkowitz, Henry, "Academic–Industry Relations: A Sociological Paradigm for Economic Development", in Leydesdorff, Loet and van den Besselaar, Peter (eds), *Evolutionary Economics and Chaos Theory: New Directions in Technology Studies* (London: Pinter, 1994).

[16] Brooks, H., "Research Universities", *op. cit.*, p. 204.

[17] Guston, D. and Keniston, K., *The Fragile Contract*, *op. cit.*, p. 2.

[18] *Ibid.*

[19] Brooks, H., "Research Universities", *op. cit.*, pp. 204–205.

funds and as witnessed by their unwillingness to set priorities";[20] and university scientists' neglect of teaching and research in order to profit from consultancies and participation in spin-off corporations.

The implication of all this is that academic scientists have become arrogant and self-indulgent, rejecting legitimate oversight of the use of public money, claiming "entitlement" to ever-escalating funding, and being "unwilling to share responsibility for dealing with the growing deficits, trade imbalances and other economic ills of their country."[21]

I have quoted and reported these arguments to demonstrate that this is a rather general, "moralistic" (or "moralising") discourse, in which few of the real problems of science are mentioned. And if they are, it is not to propose genuine solutions, but to use problems as a springboard for a broader, less focused and hence less tractable critique addressed to the scientific community—namely that it is "unwilling to share responsibility for dealing with growing deficits, trade imbalances and other economic ills of their country".[22] It is indeed strange that, on the one hand, the scientific community is charged with not contributing enough to the competitiveness of industry and ignoring economic realities, and on the other is accused of spending more time on profitable spin-off activities than on teaching, and collaboration with foreign companies instead of national ones.

Collaboration on industrial projects or the application and commercialisation of the products of research are time-consuming, and they inevitably interfere with the initial purposes of university researchers and teachers. (Criticism of the alleged conspicuous consumption by researchers is based on one leading university which has long benefited from significant financial contributions from industry; the case can hardly be generalised to other universities in the United States or elsewhere.) Collaboration with multinational corporations is a natural consequence of participation in an increasingly internationalised research and development market. Indeed, American companies were among the first to delocalise their research and development and to make use of the research structures of other countries. In the 1960s three quarters of all foreign investment was made by American multinational corporations; now three quarters is directed towards the United States (and Europe) by German, Japanese and other firms.[23] Where is the evidence that the receiving countries do not benefit from these investments?

The last question is: who is speaking? The answer is that all these articles base their list of critiques on the same source—United States congressional

[20] Guston, D. and Keniston, K., *The Fragile Contract, op. cit.*, p. 2.
[21] *Ibid.*, p. 3.
[22] *Ibid.*
[23] See Maarten de Vet, Jean, "Globalisation and Local and Regional Competitiveness", *STI revue* (Paris: OECD, 1993), pp. 89–121. Nevertheless, between 1986–89, American corporations increased their domestic research and development by 6 per cent, but by 33 per cent abroad; see Madeuf, Bernadette, "Internationalisation de la R.D.: réseau global de R.D. et potentiel scientifique et technique national", Colloque Mastech, Lyon, 9–12 September, 1991.

committees. Yet over the past few years a very similar discourse has been diffused to other countries, in which the funding and general material conditions of science and universities are far less enviable than those of the American scientific community. France is a case in point. In January 1982, François Mitterrand, the new socialist president, settled the agenda for the national scientific community:

> Research is one of the keys, perhaps the key, to renewal and thus to overcoming the crisis. Only a major research effort will enable France to take its place among those few countries capable of mastering technology and so maintaining their independence. . . . We must place research where it needs to be, not in an isolation that confines scientists to their centres or laboratories, but at the crossroads of all the great problems of our society.[24]

In the 1960s and 1970s, similar attempts by the French public authorities to reinforce the relationship between research and industry were greeted with hostility in the research community, which saw them as an attack on the autonomy of science, and as introducing a mercantile spirit into the sphere of "disinterested activity". In the 1980s, however, the call to mobilise was effective. This is often seen as paradoxical, but several factors converged to produce this result. First, the economic crisis was at its deepest and there was a general belief that French industry needed help in its urgent task of innovation and modernisation; this argument was played on the patriotic string, as often in the past. Second, many firms were nationalised, or in the process of being so, and most of those doing intensive research and development were public ones. Third, the socialist government was regarded as politically and sociologically representative of the majority of scientists and university teachers. Finally, the government confirmed its interest in science by raising the funds for research.

By 1990, the minister for research and technology, Hubert Curien, could congratulate himself that "over the last decade, we have made enormous progress in encouraging relations between public research and industrial milieu. Whereas in the past it was sometimes seen as strange, not to say suspect, for a public laboratory to work with an industrial firm, it is now considered as surprising that some research institutes do not have any contact with industry".[25]

This appraisal was justified. The results are quite impressive where the increase in number of contracts, contracting laboratories and industrial firms, as well as the financial volume of these contracts are concerned.[26] Neverthe-

[24] Opening speech at National Colloquium for Research and Technology, 13 January, 1982, in *Actes du Colloque National Recherche et Technologie* (Paris: La Documentation française, 1982), p. 67.

[25] Interview with Guitta Plessis-Pasternak, "L'effort de recherche au risque de finance", *Le Monde*, 3 March, 1990.

[26] Vavakova, Blanka, "Building 'Research-Industry' Partnerships Through European Research and Development Programs", *International Journal of Technology Management* (IJTM), special issue on Evaluation of Research and Technical Change, X, 4–5–6 (Spring 1995).

less, some years later the new director-general of the largest research body in France, the Centre national de la recherche scientifique (CNRS),[27] made a veiled criticism of the scientific community's contribution to the national economy in an analysis of in-house research and development by French firms:

> It is necessary to reinforce our partnership with business firms and the external world generally . . . I am entirely in favour of preserving a large degree of freedom for basic research. But I consider it imperative that this research is in direct contact with the real economy. . . . Researchers should recognise that in the present crisis it cannot be taken for granted that there will always be more money to develop knowledge or research. . . Until recently, we have lived with the dogma that it was necessary to support the development of knowledge. This argument was possible in the period of economic growth, when a reasonably enlightened government could finance the growth of basic research and there was enough money to do so. The public research budget in France is adequate; it is only the amount industrial firms spend on research and development which remains insufficient compared with other countries.[28]

This discourse has the merit of expressing frankly the basis for renewing the call to tie public research more closely to industrial needs. If under the socialists the promotion of research–industry collaboration was accompanied by an increase in research and development funds for universities and research institutions, the present call is clearly aimed at linking a research sector whose funding has already begun to shrink—and is likely to shrink further—to an industrial sector which has always been and is designated to remain the principal beneficiary of public research and development funds.

Do Universities Consume Vast Resources?

The idea of a "new contract" implies that it was the universities which were the main consumers of government research and development funds because of well-publicised and well-funded programmes for "big science". In fact, government funds to universities barely constitute 12 per cent of all state allowances to research in France, and only 19 per cent in the United Kingdom. Not only do French universities conduct little research, they cannot even accomplish their basic task of teaching and training their overflowing student bodies—and this has led to numerous student strikes over the years.

In France, the number of university students almost doubled between 1982 and 1992, but neither the number of teachers nor financing per capita has grown proportionally (Table I). The data show that it is not university "research" which is responsible for the escalating growth in expenditure on universities, but rather the increase in enrolments.

The increase in the number of students is due to several factors. All students with the *baccalaureate* can start university studies, except in the case

[27] CNRS and its institutes employ 11,386 researchers and 15,081 technical and administrative staff (Projet de loi de finances 1995). Yet 10,000 of those paid by CNRS work outside it, in universities, business firms and in public and private enterprises.

[28] Aubert, Guy, "La recherche fondamentale doit être en prise directe avec l'économie", interview by Alain Perez in *Les Echos*, 13 March, 1995.

of some faculties or programmes where a *numerus clausus* operates, as in medicine or some "elite" schools such as the École polytechnique. Prolonging studies and obtaining higher diplomas have been seen as the best strategy to avoid unemployment, which affects in particular the younger segments of society.

Finally, the fact that society values higher education and non-manual work contributes to the growth of the university population. It is increasingly evident that, in the absence of adequate financing, this population can no longer be properly supervised and trained. In France the situation is aggravated by the fact that the system of higher education is mostly public—in 1994, 70 per cent of students enrolled in public universities—and it is still highly centralised.

TABLE I

University Students, Teachers–Researchers and Total University Personnel in France, 1982 and 1992

	1982	*1992*
Students	1,263,000	2,100,000[a]
Teachers-researchers	25,100	33,084
Total university personnel	39,500	49,132
Number of students by teacher-researcher	50.3	63.5
Number of students by other university personnel	87.8	130.8
Higher education expenditure (million current ppp $)	1,861,000	3,975,000
Per capita of students	1,473	1,893
Per capita of total personnel	1,401	1,821

[a] Number of students in 1993.

SOURCE: Ministère de l'Enseignement Supérieur et de la Recherche (MESR), *Atlas régional*; Mission de la Carte Universitaire et des Affaires Régionales; Direction générale des Enseignements Supérieurs.

Regional authorities came to rescue of universities in their own regions following the report of a special committee, which in 1990 evaluated conditions in the universities as disastrous. In 1991, regional authorities contributed 423 million francs to the funding of universities. But compensating for the state's failure has created a somewhat paradoxical situation, at least from the perspective of the regional governments. Indeed, they complain that they have to finance state projects but cannot influence curricula, the content of training and research programmes, or even the appointment process or management of personnel. These matters have always been the prerogative of the central government and remain so, despite some recent efforts at administrative decentralisation and attempts to increase the autonomy of universities.

The regional governments resort to using loopholes, or they simply ignore existing rules in attempting to build up the intellectual resources—whether in research and teaching—of their regions. Their primary goal is to attract companies with generous research and development spending and persuade them to relocate facilities to their region. They thus finance faculties, departments and education programmes in fields related to the economic objectives of the region, hoping that later the central government will officially approve these initiatives.

As in the United States, these initiatives have led to growing criticism of "local competition" for research resources. However, there is great inequality in territorial distribution of such resources in France, as most regions remain heavily dependent on the central government but receive little from the state—more than half of public research and development resources are concentrated in just one out of 22 regions, and 80 per cent in four regions, leaving the remaining 20 per cent to be spread over 18 regions. Compounded with the necessity for regions to create new resources for their local economies, the current situation can only lead to a further decline in existing conditions, marginalising many regions from the dynamic growth which local research and development resources would appear to stimulate. In seven French regions—Bourgogne, Bretagne, Champagne-Ardenne, Basse-Normandie, Haute-Normandie, Nord-Pas-de-Calais and Poitou-Charentes—laboratories receive more than 60 per cent of their research and development budget from regional councils. In 11 others, regional governments fund more than 50 per cent of the research and development budgets of local laboratories.

A further note of caution is needed with respect to regional financing of university research. The growing intervention of regions into research and university education generates worries about their propensity to distort existing curricula and programmes, whether under the influence of powerful industrial lobbies or as a result of their own "high tech fantasies".[29]

The same problem is already evident in the growing collaboration of universities with industry. According to the Ministry for Research in 1993, French universities' contracts with companies were worth 961 million francs.

Undoubtedly, contracts with industrial firms are financially profitable—but they are also time-consuming. While public officials and university administrators may approve, those directly in charge of teaching and students are frequently exasperated by the lack of availability of professors who are engaged with industry. The legitimacy accorded by political discourse to this type of activity weakens the authority of persons who might wish to question it. The students themselves have no power to change the situation. Irvin Feller has correctly pointed out that universities are very eager to discuss projections of revenues, but less keen to discuss the associated costs. It is not unimagin-

[29] See Massey, Doreen, Quintas, Paul and Wield, David, *High Tech Fantasies: Science Parks in Society, Science and Space* (London and New York: Routledge, 1992).

able that some will find themselves engaged in a chimerical economic pursuit.[30]

Identifying the Real Beneficiaries of the Old Social Contract

The tendency to confuse the interests of the economy with those of society—as current calls for closer research–industry relations have done—and to favour fields of research which appear at a particular moment to be economically profitable, is almost constant. Yet, if the economy is difficult to plan, so too are science and technology. It is not surprising, therefore, that most efforts are not so much "strategic", as exercises in *post-hoc* planning with its perverse effects: overinvestment in one scientific field to the detriment of others which might become critical in the future.

There is no ideal standard against which to measure the amount that should be spent on researchers, or how many researchers should be employed. Joseph Ben-David pointed out that, in order to establish the level of support for science, countries have taken the situation in a few pioneering centres as their frame of reference.[31] John Irvine, Ben K. Martin and Phoebe Isard who have analysed French government funding over the past 30 years, think that "the priority accorded to research funding depends heavily on the views of the President".[32] From 1957 to 1967, under the presidency of General de Gaulle who favoured science and technology, expenditure on research and development rose from 1 to 2.2 per cent . By the late 1970s, under President Pompidou, who was less in favour of the public support of research and development, the figure fell back to 1.8 per cent.

There were modest increases in national research and development spending under President Giscard d'Estaing, the long-term aim being to raise the total to 2.3 per cent of gross domestic product by 1988. In the same vein as President Pompidou, Prime Minister Jacques Chirac in 1986 abolished the Ministry for Research and Technology and introduced cuts of 5 to 10 per cent in real terms for civil research and development in his government's first budget. Although there was a small rise in spending the following year, this went entirely to defence research and development; civil research was reduced by a further 2 per cent and basic research by 5 per cent.[33]

The re-election of a socialist government in 1988 brought about an immediate restoration in the fortunes of civilian research, with an increase of

[30] Feller, Irvin "Universities as Engines of R&D-based Economic Growth: They Think They Can", *Research Policy*, XIX (1990), pp. 335–348.

[31] David, Ben-Joseph, *The Scientist's Role in Society: A Comparative Study* (Englewood Cliffs: Prentice Hall, 1971).

[32] Irvine, John, Martin, B.K. and Isard, Phoebe, *Investing in the Future: An International Comparison of Government Funding of Academic Related Research*, report of a study sponsored by the United Kingdom Advisory Board for the Research Councils and the United States National Science Foundation (Huntingdon and Vermont: Edward Elgar, 1990).

[33] *Ibid.*, p. 79, according to Walgate, R., "More for Defence, Less for Science", *Nature*, CCCXIII (1986).

7 to 8 per cent in the 1989 research and development budget, including a twofold increase of funds for the national priority programmes,[34] and the re-establishment of the Ministry for Research and Technology. The reduction of research funding returned again under the government of Edouard Balladur and continues under the presidency of Jacques Chirac.

If there is any personalisation of science policy, it must be related in this case to the "presidential regime" since 1962, which more than anything appears to be influenced by the values of political forces behind the president—the emphasis on military versus civilian research and development is an example. But as these shifts in policy show, historical context undoubtedly has an effect. De Gaulle's pro-science stance in the post-sputnik era is an example. Christopher Freeman has taken the point of historical context further by distinguishing three phases in the science and technology policies of OECD countries since the Second World War:

> In the immediate post-war period . . . the emphasis was strongly on the "supply side" of the science–technology system and especially on building a strong research and development capability. In a second period in the late 1960s and 1970s . . . the emphasis was much more on the "demand side". . . . There was a growing awareness of limits to growth in research and development budgets. . . . The value of fundamental research, which had been rather generously treated in the first phase was increasingly questioned and its growth was slowed down.
>
> Finally, in the most recent period, there are increasing attempts to integrate both these approaches and to link up policies for science and technology with policies for industry and for economy more generally.[35]

The budget appropriations or outlays of the governments of France, Germany and the United Kingdom in 1992 (Table II) indicate that their science policies reflect the concerns of industry and the economy far more than "the social needs of larger society". Indeed, the share of "social, non-economic objectives" such as urban and social planning, environmental protection, health and social development and services, barely reaches 5 per cent in France, and 10 per cent in Germany and the United Kingdom, according to OECD data. Only the United States' spending is more than 15 per cent of governmental budget appropriations or outlays for research and development (GBAORD) on the same objectives. If the "advancement of research" and "general university funds" are added to this category, it scarcely extends to the third of all such outlays in France and the United Kingdom.

With the exception of Germany, defence is the biggest consumer of the governmental research and development budget in each of the other three countries (Table III). Moreover, despite the end of the Cold War in 1989, the budgets for defence in all four selected countries continued to grow, with only France reducing its defence spending in 1991.

[34] Coles, P., "New French Government's Windfall for Research", *Nature*, CCCXXXIII (1989).

[35] Freeman, Christopher, "Quantitative and Qualitative Factors in National Policies for Science and Technology", in Annerstedt, Jan and Jamison, Andrew (eds), *From Research Policy to Social Intelligence: Essays for Stevan Dedijer* (London: Macmillan, 1988).

TABLE II

Government Budgetary Appropriations and Outlays for Research and Development by Socio-Economic Objective, 1992

(percentage of total)

Objectives	*France*	*Germany*	*UK*	*USA*[a]
Social non-economic[b]	31.4	59.0	32.7	21.3
National security (defence)	37.4	10.5	46.3	59.4
Economic[c]	30.6	31.7	21.0	20.9
Other and unclassified	0.4	10.5	0.3	–
Total[d]	96,264.0	31,140.1	5,587.5	72,867.0
percentage	100.0	100.0	100.0	100.0

[a] Federal government only. Education is not a federal matter but state universities do receive research grants from national bodies, usually for individuals.

[b] Urban and rural planning, environmental protection, health, social development and service, advancement of research (in France may include CNET in telecommunications, applied research institutes, e.g. INRIA, and the transport sector, e.g. INRET).

[c] Agriculture, forestry, fishing, industrial development, energy, science and technology infrastructure, earth and atmosphere, civil space, transport, telecommunications.

[d] In national currencies.

SOURCE: EAS Data Bank (STIU) (28).

In every country, industrial development, non-military space applications and other economic objectives absorb a large part of GBAORD. In France, they are benefiting from an even larger part of this budget than the advancement of scientific research and general university funds. It appears that the industrial enterprise sector in France finances a larger share of gross domestic expenditure on research and development than the state does (Table III). However, although the amount spent on business research and development (BERD) has shrunk somewhat over the past decade, the French government was still funding 22.3 per cent of such expenditures in 1992, which is significantly higher than the 10 per cent of BERD financed by the German government, or the 14.6 per cent financed by the United Kingdom government. Only the United States gets near the French figure.[36] Yet in France the shrinkage has been more than made up by other public transfers, notably the European research, technology and development programmes aimed at improving the competitiveness of European industry. In 1992, the percentage of business research and development expenditure in France financed by foreign sources reached 12 per cent, while in the United Kingdom it rose to 16 per cent in 1991. These two countries are the most intensive users of European research, technology and development programmes.

[36] OECD, *Main Science and Technology Indicators 1994*, 1 and 2 (Paris: OECD, 1994).

TABLE III

Gross Domestic Expenditure on Research and Development (GERD), 1991

Percentage	*France*	*Germany*	*UK*	*US*
GERD financed by state	44.3	37.1	35.4	38.8
BERD financed by state	22.3	10.0	14.6	22.5
GERD performed by enterprises	62.1	66.9	62.8	72.6
GERD performed by higher education sector	16.4	17.0	17.5	14.4

SOURCE: Data from OECD statistics.

Moreover, the enterprise sector in France is the main beneficiary of research undertaken in public research institutions, such as the Centre national d'études des télécommunications (CNET), the Institut national de recherche en informatique et en automatique (INRIA) and others, set up expressly for this purpose. According to French government statistics, the Centre national de la recherche scientifique, which employs almost 50 per cent of all the researchers and 40 per cent of total research and development personnel in public academic research institutes—there are relatively few private or semi-private research and development institutes such as the Institut Pasteur—receives only 24.5 per cent of the government's budget for research and development.[37] According to the Ministry of Higher Education and Research, basic research in public research organisations accounts for 46 per cent, applied research for 36.3 per cent, and experimental development for 17.7 per cent (Table IV).

TABLE IV

Types of Research in the Public Sector in France

	Basic research	*Applied research*	*Experimental development*	*Total of intra-mural expenses*
1989	45.3	36.0	18.7	100.0
1990	44.3	34.8	20.8	100.0
1991	46.0	36.0	17.7	100.0

SOURCE: MESR, *Recherche et développement dans les Organismes publics: Résultats 1991* (Paris: MESR, 1994).

Thus, more than half the research performed in academic institutions is oriented towards immediate applications or product development. But even these data do not reflect correctly the size of the transfers made to industrial enterprises or allotted to economic objectives through government funding of research in public research institutions. First, for several research institutes

[37] Projet de Loi de Finances 1995.

which were set up for applications in industry, agriculture or transport,[38] no distinction is made in ministry statistics between basic research, applied research and experimental development, which are taken as a totality to be performing basic research. Although to facilitate relations between the private and public sectors the government did create a distinction between research institutes which are supposed to perform basic and applied research—the Établissement public scientifique et technique (EPST) and the Etablissement public industriel et commercial (EPIC)—a not insignificant amount of the research undertaken by an institute like INRIA while classified as an EPST, is, in fact, applied research and development. If the funds for so-called "oriented" and for "non-oriented" research are differentiated, the latter accounts for only a third of the national research expenditures in France (Table V).

TABLE V

Distribution of National Research and Development Expenditure in France

Oriented research	*Billions of francs*
Defence	29.9
Major programmes[a]	23.9
Finalised programmes[b]	11.7
"Incentive funds"[c]	2.0
Training by research[d]	1.5
Basic research	25.5

[a] "Technological" programmes for space, aircraft, nuclear, ocean and electronics.
[b] Funding of organisations and services of different ministries brought together mostly for experimental and applied research.
[c] Funds to stimulate industrial research in SMEs and large enterprises.
[d] Half allocated to doctoral grants and half to research in engineering schools.

SOURCE: MESR, *Recherche et développement dans les Entreprises: Résultats 1991* (MESR: Paris, 1994).

Even this could be an overestimate if it were based on a "widely accepted definition of basic research [which] has come to focus on the absence of a concern with practical applications rather than the search for a fundamental understanding of natural phenomena".[39] Contrary to received opinion, therefore, researchers in France are mainly oriented towards practical research and

[38] E.g., INRIA, Institut national pour la recherche agronomique (INRA), Centre national du machinisme agricole, du génie rural et des eaux et forêts (CEMAGREF), and Institut national de recherche sur les transports et leur sécurité (INRETS).

[39] Conversely, "research directed toward . . . practical goals has made important contributions to areas that are unhesitatingly categorized as basic"; see Rosenberg, Nathan and Nelson, Richard, R., "American Universities and Technical Advance in Industry", *Research Policy*, XXIII (1994), p. 332.

the bulk of government research and development funding goes to research with immediate utility. Indeed, the programmes devoted directly to economic development absorb a large part of the civilian research and development budget in all selected countries, most particularly in France (Table VI).

TABLE VI

Governmental Funding for Economic Development
(percentage)

	1988	*1989*	*1990*	*1991*
France	34.7	33.1	32.8	33.0
Germany	28.7	26.7	25.9	25.5
United Kingdom	33.6	33.5	32.0	28.8
United States	23.3	22.7	22.0	22.1

Note: These percentages may not be the same as those in Table II because they were aggregated by the French government on an unidentified basis.

SOURCE: OECD, *Basic Science and Technology Statistics* (Paris: OECD, 1993).

The very high share of governmental research and development funding in France allocated to "economic development" is due to a number of factors. First is the traditional role of the state in the economic and technological development of the country, and the lower investment on research and development by French companies—1.48 per cent of gross domestic product, compared to 1.7 per cent in Germany and 2.04 per cent in the United States in 1992.[40] Jean-Jacques Salomon is among those who have argued that this is a result of the government crowding out private enterprise.[41] Second, state-owned enterprises in 1991 employed 40 per cent of all industrial researchers and engineers, and represented 48 per cent of the total research and development budget for all firms in France.[42] Lastly, there was considerable pressure, as in other European countries, to encourage scientists in public research organisations to collaborate directly with industry. This is reflected in the increased financing of higher education by firms between 1985 and 1990, which in France has been spectacular: an increase of 200 per cent, albeit from a very low base in 1985 (Table VII).

[40] In 1988, firms in the United Kingdom invested more in research and development than did French companies, but their expenditure on these fell from 1.47 to 1.33 in 1992.

[41] Salomon, Jean-Jacques, *Le gaulois, le cowboy, et le samourai: La politique française de technologie* (Paris: Economica, 1986).

[42] MESR, *Recherche et développement dans les entreprises: Résultats 1991* (Paris: MESR, 1994).

TABLE VII

Gross Domestic Expenditure by Enterprises on Higher Education, 1985–1990

	1985	*1986*	*1987*	*1988*	*1989*	*1990*
France	46.0	49.1	89.4	104.1	128.7	140.2
Germany	178.6	197.3	225.9	250.0	266.8	306.2
United Kingdom	111.3	128.7	139.4	181.1	191.2	196.5
United States	559.0	684.3	749.9	801.4	886.2	967.8

SOURCE: OECD data.

By 1994, CNRS had ten times more contracts with industry than in 1982. In 1991, the Institut national pour la santé et la recherche médicale (INSERM) had three times more contracts than in 1990, worth 78 million francs. Thanks to these collaborations with CNRS laboratories, the firms have been granted 200 patents a year; it is estimated that 150 enterprises have been created as a result of research carried out in CNRS and its associated laboratories. In 1992, CNRS received 20.6 million francs in lieu of licence fees for a vaccine against hepatitis B, diagnostic kits for HIV, drugs such as the anti-cancer product Navelbine, and for several software programs. Since 1981, millions of francs in licence fees have been paid to CNRS, over half—69 million—in the course of the past four years. This represents sales worth more than five billion francs for the companies concerned.[43] Partly as a result of the sales of their products—publications, seminars, tests or diagnostic kits, etc.—and partly also because of research contracts with industry, the budgetary resources of public research bodies grew from 9.9 per cent in 1986 to 13.6 per cent in 1991.

These official data are far from a faithful indicator of the extensiveness of "research–industry" relationships. Financial transfers between public research organisations and business enterprises are in fact much more important. Unofficially, the central administrations of some French research bodies estimate that up to 30 per cent of existing contracts were not notified to them by various research teams. Besides, rather than paying laboratories for their services, some companies prefer to compensate in kind through purchases of equipment, airline tickets for congresses, etc. Public laboratories often provide free help to private enterprises, especially the small and medium size enterprises (SMEs); this is particularly the case in regions which have an active policy of promoting innovation networks.[44] In fact, only lately have scientists and research organisations learned how to negotiate contracts with firms. Many started the collaboration in the early 1980s as a "patriotic" or "political" duty—to France or to the socialist government—without possessing suitable institutional structures to deal with companies.

[43] CNRS, *La Note d'information du CNRS*, 3 September, 1993.

[44] Vavakova, Blanka, "Vocation régionale de la recherche publique en France", *Revue Politique et Sociétés*, forthcoming.

After a decade of intensified collaboration with industry, legal and other structures are still missing in many research institutes. For this reason many of the French researchers interviewed expressed a preference for collaboration with industry within the context of European research and development programmes, which seem to offer better protection for their intellectual property.[45] Finally, an important part of the indirect transfers of public research resources can be seen in the total expenditure on contracts between CNRS and industrial firms of 1.5 billion French francs, of which the firms' contribution was only 716 million francs.[46]

It is interesting that contracts with foreign enterprises now account for more than 10 per cent of all CNRS contracts with industry; fully 70 per cent involve non-European firms. As yet the public authorities show no particular anxiety about this development,[47] but it is obviously the natural effect of pressures over the last decade on research institutes to develop contacts with industry. However, if the explicit motive of government policy is to increase the contribution of public research to the competitiveness of national industry, another—implicit—motive is to encourage the public sector to find alternative sources of finance for its own research. Yet, it is naïve to think that large numbers of French businesses are keen to collaborate with public research laboratories, and to pay for this collaboration.

The public authorities complain that researchers pay little attention to the economy, but it can also be said that industry pays too little attention to science. Sometimes even a systematic search for industrial partners by public laboratories has little success; when the research institute in the Nord-Pas-de-Calais region sent out a prospectus to 2,000 local firms describing the skills and services it could offer, only 10 per cent of firms showed any interest. So it is strange that public research has been held responsible for the lack of innovation of private and even public enterprises. The responsibility could also lie with the public authorities. In fact, large industrial firms—which represent only 5.6 per cent of firms in France which do some research and development—carry out 63 per cent of all national research and receive 84 per cent of public funds.[48] Despite this, a number of these firms have reduced their own costs by discontinuing contracts with public research laboratories.

Some laboratory directors in public research bodies would still prefer to cooperate with French firms, instead of being obliged to accept offers from foreign, mostly Japanese, firms in the microelectronics sector. But others, faced with meagre resources, believe that if the state is not concerned about

[45] Vavakova, B., "Building 'Research-Industry' Partnerships", *op. cit.*

[46] CNRS, MRF, "La recherche à objectifs partages et les transferts de technologie", 15 June, 1995.

[47] A possible exception is a recent effort by the Ministry of Higher Education and Research to secure prior notification and a right to control all formal contractual international relations of the research organisations and universities falling under the Ministry of Higher Education and Research.

[48] MESR, *Recherche et developpement dans les Enterprises, op. cit.*, p. 20.

its own research, it is perfectly acceptable to sell the results to the highest bidder. In 1990, French companies invested 6.5 billion francs in research and development activities abroad. This could be viewed as a drain on national resources, as has happened in Germany: when in 1992 the Hoechst company started financing a team of 80 researchers at the Massachusetts General Hospital, its decision led to a public outcry.[49] However, the globalisation of production and product distribution has also meant the globalisation of scientific resources. The same trend pushes companies to search globally for the best comparative advantage in scientific resources. Not many research institutes have the required skills, capabilities or infrastructure necessary to undertake specific research and development projects for industrial firms which themselves have large in-house research facilities.[50]

Some of the new fields of scientific research that are among the most competitive are also among the most expensive. Neither national nor transnational public funds—such as those of the European Commission—would be able to support research at the level required to meet international standards of excellence. In these fields, more and more scientists and laboratories are tempted to accept foreign private funds, even in Germany. According to some German researchers interviewed, certain universities which receive long-term financial support from large national companies have been asked not to undertake any formal collaboration with foreign competitors—actual or potential. Elsewhere, in countries where industry does not support university research, it is unfair to push researchers to participate in the "real economy", and then to criticise them for acting in accordance with economic logic or laws.

One might also note that foreign investment in a national research system is not necessarily beneficial only for the investors. It may help the general situation, especially if cuts to national funds are threatening the competitiveness of a national research base. We found several research teams in France, as well as in Germany, which doubted whether they could perform their research at an international level of excellence without contracts with foreign companies.[51] Nevertheless, there is a real problem, which cannot be viewed from a simply moralistic or cynical perspective.

Conclusions

The promotion of better relations between academic institutions and the economic sector is not a negative practice *per se*. The question is how to prevent the effects on society of a reduction in the knowledge available as a

[49] Wortmann, Martin, "Multinationals and the Internationalization of Research and Development: New Developments in German Companies", *Research Policy*, XIX (1990).

[50] The other reasons for foreign investment in research and development are outside my focus here. But it is interesting that a company such as Hoechst in 1992 invested 1,554,126 KECU on research and development.

[51] Vavakova, B., "Building 'Research-Industry' Partnerships", *op. cit.*, 1995.

public good. It is not true that cooperation with companies does not modify the research agenda of public research institutes, or that it has only a positive impact on them. It modifies their activity in ways which cannot be grasped by simply using quantitative indicators—such as the number of publications—as is often done. In fact, the publication of research results is frequently delayed for one or more years to comply with the terms of contracts imposed by the firm involved.

It is true that scientists in the public sector have gradually learned that such restrictions on their professional ethics may enable them to obtain more money by turning to the companies that impose such delays. But this is only one step away from introducing solvency criteria into public research, which especially in the medical or pharmaceutical fields may have serious consequences for the social needs of the larger society. It would be naïve to think that the danger is not real.

It is quite easy to imagine that the discourse about the "new social contract between the university and the larger society" is spreading simply through common membership in international organisations, where the American point of view cannot be ignored. But are we not also facing a recurring conservative attitude which periodically attacks the intellectual community—scientific among others—and uses it as a scapegoat for most of the social and economic ills of the day? It can be summed up in the adage "less thought, more action". Scientists themselves are echoing this ideological trend, for a number of reasons. One is the easily triggered guilt shared by intellectuals over what has been termed "non-productive work". The notion is cultivated by populist ideologies on both the right and the left.

Why should science, and not companies or governments, be blamed for deficits, trade imbalances or the lack of competitiveness of national industry? Non-utilitarian knowledge has been a relatively small cost to the state compared to the immense expenditure on research and development made by the state, especially in France, for defence or for research and development in industry. In fact, although some governments have reduced direct funding of industrial research, they have increased its indirect funding by forcing user-orientation on formerly non-industry-related research.

The social usefulness of science may remain unchallenged for a long time. But, to understand the terms of the new contract between university and the larger society, greater transparency is needed about who is determining which knowledge should be produced by public research—in universities and other institutions—and to whose advantage this knowledge is destined.

We must thus question the continued legitimacy of confounding the interests of society with those of the economy, as the discourse about "new social contracts" does. Except in some demagogic variant of Marxism, the economy has never equalled society. It equals it even less in the present context, when more and more firms are privatised and national economies are shaped increasingly by the strategies of mobile multinational firms competing in a global market for production sites as well as for scientific resources. One

can question both the grounds on which the "new social contract" equates the university with science, and regret the consequences of doing so. This is a truly moral matter of responsibility over the real social needs of the larger society, which concerns not only scientific researchers but also policy-makers.